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CONTENTS.

Editorial 703
High and Low Voltage Incandescent Lamps, by John W. Howell 705
Impulse Water Wheel Experiments, by E. A. Hitchcock 706
Municipal Ownership, by M. J. Francisco 707
The Telephone Repeater.—III., by F. Jarvis Patten 710
Progress of the Enclosed Arc Lamp, by Louis B. Marks 712
A Profitable Day Load for a Large Central Station, by C. H. Wilmerding 714
Electric Lighting Subways, by Wm. Maver, Jr 715
The Validity of the Berliner Patent, by Geo. W. Sutton 716
The Canadian Electrical Association Convention 717
Electrical Features at Niagara 719
Digest of Current Electrical Articles, compiled by Carl Hering 735
Brush Apparatus in the Vicinity of Niagara Falls 740
Para Pneumatic Pulley 740
A New Switchboard Drop 740
Short Enclosed Arc Lamp 740
A Direct-Connected Lighting Plant 741
A German Crookes Tube 741
Cluster Reflectors 741
A Well-Known Automatic Engine 741
Arc Lamp Hanger 742
Triplex Power Pumps 742
A Novel Speed-Reducing Device 743
Telephone Apparatus 743
A New Telephone Magneto Bell 744
Automatic Elevator Controller 744
Departments:
Financial Intelligence 745
Special Correspondence 745
General News 747
Obituary Note 747
Trade and Industrial Notes 748
Business Notice 749
Illustrated Record of Electrical Patents 749

THE CONVENTION.

The twentieth annual convention of the National Electric Light Association, which opens on June 8, at Niagara Falls, promises to be the most satisfactory meeting of that body ever held. The programme is especially interesting, and the indications are that the attendance will be unusually large.

The association can look back over its own record with feelings of peculiar satisfaction. There has hardly ever been such wonderful progress in any art as in that represented by the men who will meet at Niagara next week. Their labors have largely contributed to this advance, and have gone far to make electric lighting what it is at present. They have combated with the difficult conditions that surrounded early central-station practice, and have reduced the production and distribution of electricity to exact business methods.

Among other things that these pioneers in the electrical business had to learn was the technical side of their work. With each succeeding convention the character of the technical papers read has been higher, until, nowadays, the meetings present almost a semi-scientific aspect. It is not to the technical side alone, however, that these "experience meetings" address themselves. The ever-present question of "how to make it pay" forms the basis of the larger part of the addresses and discussions.

The most marked feature of these conventions is their eminently practical nature. The men who compose the association are representative of the best class of American business men, intelligent, practical, progressive and keenly alive to every opportunity. There are few idle words spoken when such men gather to learn of each others' experiences.

The papers this year are of unusual interest, and some of them deal with questions of great importance; as, for example, the methods of charging for current. Important and valuable as the papers are, they are not so vitally interesting to electric-light men as the topical discussions. These seem to have been most felicitously chosen this year, and cannot fail to elicit a beneficial exchange of experiences.

ELECTRICITY AT NIAGARA.

In this number is presented a series of short descriptive articles, copiously illustrated, which cover the whole ground of the electrical industries that have centred around the great cataract. There is no place more interesting to electricians than this gigantic water power, whose electrical utilization seems to be so nearly realized. It seems fitting that Niagara should have been chosen as the place for the convention of the National Electric Light Association, as it probably contains more of interest to electric-light men than any other city on the face of the earth.

MUNICIPAL OWNERSHIP OF ELECTRIC LIGHT PLANTS.

On another page Mr. M. J. Francisco has given vigorous expression to his opinions concerning the municipal ownership of electrical distribution plants. Probably no fallacy possesses a greater vitality than this particular delusion of municipal corporations. The experience of the many cities and towns in this country which have undertaken electric lighting has been so uniformly

disastrous, and has resulted in such a deplorable condition of local politics in most of them, that it seems no further warning should be needed to prevent even the consideration of the subject by the councils of enlightened communities. Every day, however, the discussion of this time-worn theme is taken up in some part of the country, very frequently is brought to a vote, and much too frequently to the actual trial of the experiment.

Putting aside all considerations of political economics and of the legal right of cities to undertake business in competition with their citizens, the fact is immediately apparent that no other calling requires greater experience, more careful education, or longer preparation than the successful installation and superintendence of an electric light plant. This is not a vocation in which the average politician shines, yet the result has been in most cities where the experiment has been tried that sooner of later the central station is turned over to the class of men who usually inherit the political plums under our municipal governments. The result in such cases can be foreseen from the beginning, and it does not require an unusual gift of prophecy to foretell the inevitable disaster.

There is another point of view from which the question of municipal ownership assumes an even more dangerous aspect. If it were to happen that a municipality successfully conducted the business of electric lighting there is little doubt that this success would lead them very shortly to undertake other businesses of the same semi-public nature which are now satisfactorily managed by private corporations. Among these the most important is the street railway, and the ownership of these has been made the subject for the deliverance of demagogues for several years past. So far no American city has undertaken the control of such railways, except by burdening the companies owning them with an almost iniquitous system of taxes. It is the duty of those who desire to see the electrical industries prosperous to use every means in their power to expose the fallacy of municipal ownership of any industry whatever that can be successfully undertaken by private parties.

TELEPHONE REPEATERS.

The interesting series of articles by Mr. F. Jarvis Patten, which closes in this number, contains much food for reflection. It is a curious fact that so far the efforts of inventors in the direction of producing a practical telephone repeater have met with uniform lack of success. The utility of such a device is so apparent, and its value so enormous, that it is remarkable that it has not yet appeared. There is an old rule that whenever a thing is needed very greatly it sooner or later makes its appearance, and this is particularly true in regard to electrical inventions. It does not seem possible that it can be much longer before a perfected repeater will be in general use. Until that time the probabilities are that we will not have inter-continental telephony.

It seems that the telephone repeater will provide, eventually, the solution of the difficult problem of telephony through long submarine cables. While it is not difficult in the present state of the art to operate specially constructed land lines up to and even exceeding 1000 miles in length, the difficulties of the operation of long cable circuits are appalling. It is not impossible that by subdivision of the cable and the use of repeaters we may be able in time to converse with our friends in Europe. Whether or not the apparatus foreshadowed in Mr. Patten's article will be the means for the accomplishment of this much-to-be-desired result must be left to the future to determine, but it is greatly to be hoped that either this or some other simple device will soon be found to solve the difficult problem now confronting telephone engineers.

ACCUMULATORS FOR ELECTRIC ELEVATORS.

There are few situations in which accumulators are more useful than in connection with electric elevator plants, especially those in which the motor works only in hoisting an unbalanced car. No class of service imposes more difficult strains and loads upon the generating plant and conducting system than the electrical operation of elevators, and this is especially true in small installations, where there is no large number of motors among which to average the excessive starting currents.

The use of accumulators, especially where there is only one elevator, would effect an immediate reduction in the capacity of the generating plant, if a specially generating system were installed, or a great difference in the demand for current upon the supply conductors in cases where the elevator motor is supplied from an external source. These latter cases are probably the most frequent, and a study of the proper conditions under which an installation of accumulators would be desirable would certainly repay those engaged in this class of work. Broadly, it may be said that the economical effect of accumulators in such a plant would cease whenever the peaks in the load curve approached a certain proportion to the whole load, to be determined separately for each individual installation.

There is also another use for accumulators in this connection that would seem to deserve attention. In systems where the elevator car is allowed to descend by gravity, operating the motor as a dynamo through a resistance, there seems to be no good reason why the currents thus generated should not be led into a suitable battery of storage cells, and used to assist in the upward driving of the car. This would increase the efficiency of the whole system by a large percentage, decrease the size of the generating plant necessary, and at the same time provide a reservoir of energy available to bridge an accidental failure of the supply current for a short time.

American engineers are only beginning to appreciate the importance of accumulators in connection with many intermittent uses of electric power. It is gratifying to see that in some recent large installations of electric elevators, even under circumstances where their availability is less apparent than in smaller plants, storage batteries have been utilized with great advantage in the way indicated above.

PROFITABLE DAY LOAD.

The article by Mr. C. H. Wilmerding in this number is worth the careful attention of central station men. The subject of a proper schedule of charges for electric lighting is vexed and unsettled, but certainly one that will repay close investigation. The prevailing practice seems to be a sort of intelligent guesswork on the part of the station manager. Certain forms of meters have been designed to meet the requirements of the case, but the installation of a new meter followed by a change in the rate of charge is apt to lead to trouble with the consumer.

The system suggested by Mr. Wilmerding is simple and applicable to existing conditions, either as a new method for determining the basis of charge, or simply for the information of the station manager. In either case its simplicity commends it, while, by its means, a more intelligent understanding of the conditions governing day load can be readily reached.

High and Low Voltage Incandescent Lamp.

BY JOHN W. HOWELL.

The patents granted to Mr. Edison early in the 80's, which cover his lighting system, show an intuitive knowledge of the subject in all its details, which is even more remarkable when considered in the light of present practice than it appeared at that time. A careful reading of these patents by any one familiar with central station practice to-day cannot fail to leave in the mind of the reader the very highest admiration for the mind of the inventor, to whom the word "genius" is most properly applied.

In the fall of 1880, Mr. Edison lighted the houses and streets of Menlo Park with 110-volt incandescent lamps. Why did he make his lamps for 110 volts? Why not an even 100 or 125 or 150 or 200?

His physical sense and intuitive knowledge of the limitations placed upon him by the materials at his command, and the laws of nature led him to make his lamps for 110 volts. Sixteen years have witnessed a remarkable development in incandescent lighting, both in lamps and apparatus, but the standard voltage for incandescent lamps to-day is between 110 and 120 volts.

In recent years transformer systems have made large use of 55-volt lamps, which on account of their thicker filament can stand abusive pressures better than 110-volt lamps, but as these systems are made more perfect, the 55-volt lamps are being displaced by the 110-volt type.

During the last three or four years the installation of plants in which the distribution of power was the first consideration and lighting was secondary, has created a demand for 220-volt lamps, which has increased quite rapidly, so that at the present time a considerable business is done in these lamps, and the special appliances necessary for their safe use have been developed.

While the use of these lamps in this country has been almost entirely confined to power plants, long-distance lighting, and outlying districts of three-wire systems, they have had a much more extended use in England, where a number of city lighting plants have abandoned 115-volt lamps for the 220-volt type. The published reports of the performance of these lamps have been so very favorable that the subject has become one of considerable prominence at the present time, and leads to the discussion of the relative merits of different types of lamps and their adaptability to the different conditions under which lamps are used.

The advantage of high voltage lamps, which makes them so desirable is the great saving in copper due to their high resistance and small current. Two hundred and twenty-volt lamps can be installed with about one-quarter the copper necessary for 110-volt lamps, and distances can be covered by a 220-volt system which would be prohibitive with a 110-volt system. For ordinary distances, part of the saving in copper made possible by using 220-volt lamps may be sacrificed and the percentage loss in the conductors made less, with the very great resulting advantage of a steadier pressure with changing loads and less difference in pressure between different parts of the system.

These very great advantages of the high voltage lamp have long been well understood, and the only thing which has stood in the way of their realization has been the difficulties in the manufacture of the lamps.

The size of the filament for an incandescent lamp depends upon its candle-power, voltage, and watts per candle, and also upon the specific resistance and the radiating power of the filament itself. The best filaments known to-day are made of a base of amorphous carbon with a coating of graphitic carbon. The graphitic coating makes the filament much more stable at high temperatures, and by changing its radiating power causes it to yield a larger proportion of light rays at a given temperature. Both these causes make the filament with the graphitic surface better than the uncoated base. The graphitic coating is seven times as good a conductor as the base, and by regulating the thickness of the shell, we can obtain quite a range in the specific resistance of our filaments, which is of very great assistance in making lamps of various voltages, as by thus varying the specific resistance we can make lamps of considerable range of voltage without making proportionate changes in the length of the filament, which would be necessary if all were made to have the same specific resistance. The stability which this shell gives to a filament depends somewhat upon its thickness. If the shell is too thin it will not be a benefit to a filament, but will be a disadvantage, because it will not stay on, and being seven times as good a conductor as the base, its destruction will add very much to the resistance of the filament, which at constant voltage will cause a great loss of candle-power.

Since the shell must be made of a definite thickness to be useful, as the size of the base is made less the specific resistance of the finished filament will be less, so the very thin filament necessary for a high voltage lamp will be thinner than it would be if its specific resistance were the same as the filament of lower voltage. The limit of the usefulness of this graphitic coating is reached when the thickness of coating necessary for good results makes the base necessary to give the proper dimensions so thin that it cannot be made practically.

The voltage at which this limit is reached depends upon the candle-power of the lamp, and the highest voltage which can be used without a sacrifice of quality or efficiency in the lamps, depends upon the lowest candle power lamps which it is desirable to use in large quantities. The limit is reached at about twelve candles for 110 volts, and lamps of this voltage of less than this candle-power will be inferior to 16-cp lamps in efficiency or performance. For 220 volts the limit is twenty-four candles, while for fifty-five volts it is six candles. If the 16-cp lamp is to remain the standard, the highest practical voltage with the present state of the art is 150 volts, but even this voltage makes a sacrifice of economy necessary if lamps of lower candle-power are used. While an increase in the normal candle-power to twenty-four brings the 220-volt filament within the limit set by the necessary thickness of coating, it increases the difficulty of manufacture by increasing its length and making its arrangement in a suitable bulb a serious problem. This difficulty increases with higher candle-power lamps, and the lower voltage systems have the advantage in higher candle-power as well as lower candle-power lamps.

Present practice makes the 16-cp lamp the standard with a tendency toward twenty, and considerable use of lower candle powers.

The voltages in general use are from 110 to 120, and I do not expect to see these made much higher under present conditions.

It is a common practice, where many low candle-power lamps are used for signs or decorative effects, to use two 55-volt lamps in series and thus get the advantage of the more efficient lamp.

All 220-volt lamps made to-day have filaments which have either a thin shell of graphitic carbon, or no shell at all. Filaments with no coating have a very high specific resistance, and can be made short enough to be used conveniently. Filaments with a thin coating have a higher specific resistance than those with a coating of proper thickness, and can be made correspondingly shorter. Both these kinds of filaments are less stable than 110-volt filaments, and must be operated at a lower temperature, which means a greater consumption of power than is required by 110-volt lamps. One hundred and ten volt 16-cp lamps requiring fifty watts are used in large numbers, and give very good results. The 220-volt 16-cp lamps now on the market require from sixty to seventy watts each, and this is the reason why these lamps are not more generally used. Under most conditions the saving in copper effected by using 220-volt lamps is much more than offset by the increased investment in power plant and generators, and the constant expense of generating one-third more energy than is required by the 110-volt lamps.

Recent European journals have contained glowing accounts of successful installations of 220-volt lamps, and remarkable performances of 56-watt lamps of this type have been noted. We have obtained and tested samples of these lamps, and find they are 64 or 80 or 90 watt lamps on our standards, and no doubt the same relation between the two types of lamp exists there which exists here.

The production of a 50-watt 200-volt lamp requires the invention or discovery of a filament of high specific resistance, which will stand all the high temperature necessary. This may be accomplished by improving the quality of the amorphous base, until it can stand the necessary temperature, or by improving the coating process, so as to produce a thin coating on a high resistance base, which will give the benefits of the graphitic coating, and also be stable at high incandescence.

The subject is now attracting a great deal of attention, which means that all difficulties will soon be overcome, unless Nature's laws governing her materials do not permit it.

Impulse Water-Wheel Experiments.

BY E. A. HITCHCOCK.

The ever-present desire of mankind, to utilize, as it may need, the forces of nature, has led to a development during comparatively recent years of that class of water motors known as the tangential or impulse wheel, designed especially for the utilization of water-powers under high heads, where the conditions are such that the use of gravity and pressure wheels, *i. e.*, overshot, breast wheels, turbines, etc., would be mechanically impossible on account of the excessive heads, reaching in some instances 2100 feet.

On the other hand, the impulse wheel can be used for small powers to advantage on heads as low as fifty feet on account of its greater simplicity, ease of repair and lubrication, and its smaller first cost, while at the same time showing a high efficiency.

The theoretical action of the wheel lies simply in a jet of water impinging on buckets of such shape that the direction of the stream will be completely reversed and the velocity of jet on leaving the wheel equal to zero, all the energy of the stream being imparted to the wheel.

Let the velocity of the jet be represented by v and the weight of the water discharged by the nozzle per second by W, then the energy of the jet will be the same as that of a body of the same weight falling through a height h or Wh; now h equals $\frac{v^2}{2g}$, therefore the energy of the jet equals $W\frac{v^2}{2g}$.

The motion of the jet may be regarded as being produced by an impulsive force F, acting upon W, the velocity of the water in forming the jet increasing from 0 to v. Therefore the work imparted to the jet is:

$$\frac{Fv}{2} = W\frac{v^2}{2g}$$

$$F = W\frac{v}{g} \qquad (1)$$

If P is the dynamic pressure produced on the vanes of the wheel in the direction of its motion, and Θ the angle between the original and final direction of the stream, then

$$\begin{aligned} P &= F - F\cos\Theta \\ &= F(1-\cos\Theta) \\ &= (1-\cos\Theta)\,W\frac{v}{g}, \text{ from equation.} \qquad (1) \end{aligned}$$

Now $v - v^1$ equals the velocity of the stream on the vane or float, v^1 being the velocity of the vane.

Then $P = (1-\cos\Theta)\,W\frac{v-v^1}{g}$, and the energy imparted to the vane will be

$$(1-\cos\Theta)\,W\left(\frac{v-v^1}{g}\right)v^1$$

or

$$(1-\cos\Theta)\,W\left(\frac{v^2}{4g}\right) \qquad (2)$$

when the velocity of the vane equals one-half of that of the jet $v^1 = \frac{1}{2}v$. Dividing (2) by the theoretical energy in the jet $\left(W\frac{v^2}{2g}\right)$ gives E (the efficiency) $= \frac{1}{2}(1-\Theta)$ (3)

the theoretical efficiency of the vanes or buckets, equalling 100 per cent. when Θ is 0°, or when there is a complete reversal of the stream.

In the mounted impulse wheel there may be considered three sources of loss, the nozzle not being considered a part.

1. Loss due to non-reversal of steam.

2. Loss due to mechanical action, interference of particles and friction of water on the surface of the buckets.

3. Loss due to friction of the wheel in its bearings, which can be determined graphically as follows: Make $A\,A^1$ (Fig. 1) equal to the diameter of the pitch line of the buckets and $N\,N'$ the diameter of the shaft in its bearings. Now $D\,C\,E$ is the angle of action of the jet on the buckets and $F\,F_2$ the direction of that jet intersecting the pitch line at the point of bisection of the angle $D\,C\,E$. Make $C\,W$ equal to the weight of the wheel, shaft, etc., and $A'\,B$ equal to the pressure of the absorbing brake, then will $G\,W\,B$ be the position and direction of the resultant of these two parallel forces. From the intersection of $F\,F'$ and $G\,W\,B$ lay off $E\,W\,B$ equal to $C\,W + A'\,B$ and draw the original $E\,R$ passing through the centre of the shaft. Then $E\,R$ will be the resulting pressure on the bearings in the case of no friction, and $W\,B\,R$ will represent the energy required on the part of the jet in the case of no friction. For the case of friction make φ, whose tangent is the coefficient of friction, equal to the angle of repose. From the intersection of $C\,H$ with the circumference of the shaft, and through E, draw $E\,R^1$. This will be the resulting pressure

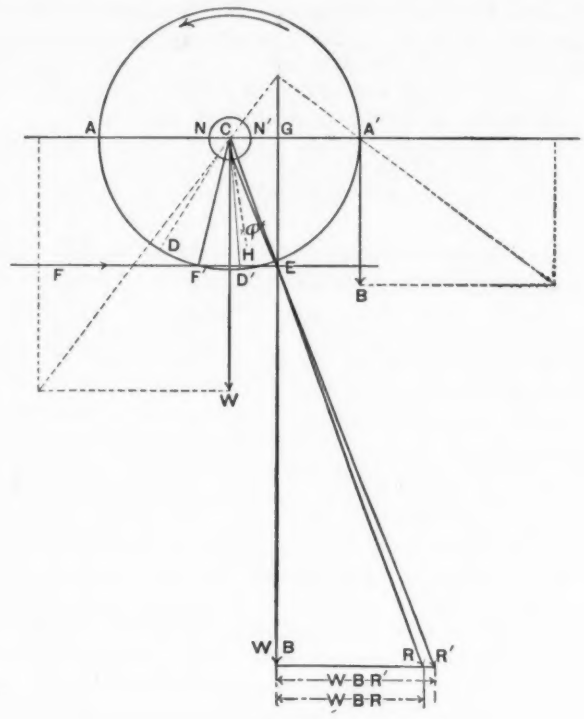


Fig. 1.

with friction, and $W\,B\,R^1$ will be the energy required on the part of the jet, therefore 100 $\frac{W\,B\,R}{W\,B\,R^1}$, will be the per cent. of loss due to friction of bearings.

Although from the above relations it is noted that high efficiency depends principally upon such a shape of bucket as to give as near

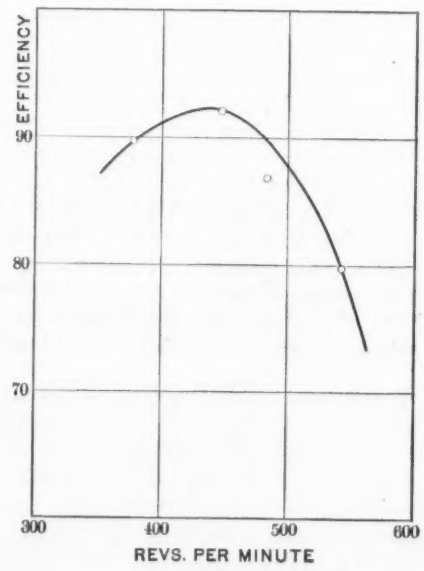


Fig. 2.

as possible a complete reversal of stream and a peripheral velocity of one-half that of the jet, yet it has been found by a series of experiments, carried on by Messrs. Donham, Frayer and Cilly in the hydraulic laboratory of the Ohio State University, that the maximum efficiency for a certain width of bucket depends upon the size of the jet and also the position of the jet in the plane of the pitch line.

The wheel used in the experiments is known as the Cascade, manufactured by James Leffel & Co., of Springfield, Ohio, is 25-⅞ inches in diameter and has twenty-eight buckets, located alternately

on each side of a sharp cutting ridge, which serves to divide the jet before reaching the buckets. A 10-in. x 7-in. x 10-in. duplex pump was used for furnishing the necessary water supply, pumping from a water bay of 2500 gallons capacity, into a stand pipe or air chamber 24 inches in diameter by 24 feet high, to which was connected, by a 5-inch pipe, the Cascade wheel tested. The wheel was located over another water bay of the same capacity as the former, a weir connecting the two. Calibrations of the nozzles used indicated the amount of water discharged and the Prony brake the amount of work developed.

Running the Cascade wheel under various speeds at a constant velocity of jet, the results, from which the curve of Fig. 2 is constructed, are as follows:

Diameter of nozzle 1 inch; length of brake arm 3.183 feet.

Number of Trial.	1	2	3	4
Velocity of jet, ft. per sec	102.4	101.7	102.3	102.1
Weight of water discharged per min	2086	2075	2085	2078
Energy of jet, ft. lbs	339600	333219	338750	336278
Net load on brake, lbs	25	30	35	40
Revolutions per minute	542 3	482.8	447	377.4
Energy developed, ft. lbs	271150	289680	312900	301900
Efficiency of wheel	79.84	86.93	92.36	89.78

Results for the best efficiencies of the same wheel with different

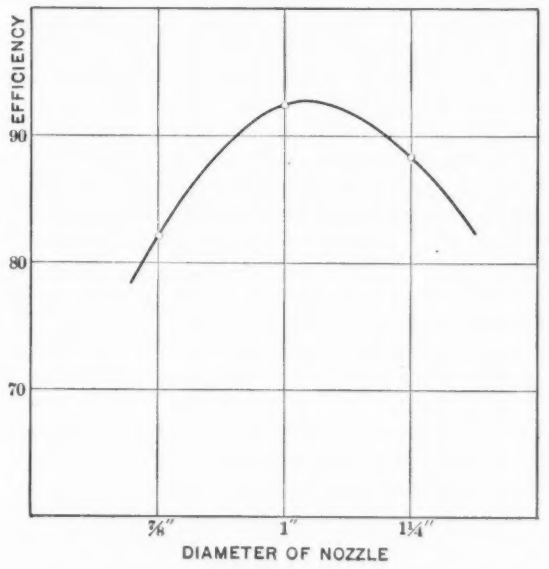


FIG 3.

diameters of nozzles are as follows, and curve of Fig. 3 constructed from the same.

Size of Nozzle.	⅞ in.	1 in.	1¼ in.
Velocity of jet, ft. per sec	99	102.3	103.5
Weight of water discharged per min	1549	2085	3340
Energy of jet, ft. lbs	235518	338750	555524
Net load on brake	20	35	55
Revolutions per minute	483.9	447	445.2
Energy developed, ft. lbs	193560	31290	489720
Efficiency of wheel	81.76	92.36	88.15

Taking the highest efficiency as found by trial, that is, the ratio of the work given off at the pulley to that stored in the jet after leaving the nozzle, the three losses would be:

First, that due to non-reversal of jet. With the wheel in question the angle of deviation from the original direction of the jet, is 163°. Therefore from equation (3) $E = \frac{1}{2}(1 - \cos 163°) = 97.81$ per cent., or 2.285 per cent. loss.

Second, that due to the friction of the bearings. Making an application to Fig. 1, trial No. 4, where the diameter of the shaft is 1¼ inches, diameter of the pitch circle 23¾ inches, weight of wheel 200 pounds, the net load on the brake is 35 pounds, and assuming the tangent of the angle of repose to be .01, the coefficient of friction, $100 \frac{W B R}{W B R^1}$ (Fig. 1) equals .26 per cent., giving a total loss due to non-reversal of stream and the friction of the bearings of 2.545 per cent., which would give for the second loss that due to the friction of the water on the buckets, mechanical action of particles, etc., for the trial in question

$$100 - 92.36 - 2.545 = 5.095 \text{ per cent.}$$

which will also include the energy of the jet loss, if any, due to the departing velocity being greater than zero.

Loss I. 2.285 per cent.
II. 5.095 "
III. .26 "
Efficiency of wheel 92.36.

Municipal Ownership.

BY M. J. FRANCISCO.

Is it beneficial to the taxpayers? Is there a valid reason for adopting it, except for political purposes? Is there a single plant that has saved money for the taxpayers, when all the facts are shown?

Advocates of municipal ownership state that lights under this system cost about half the price charged by private companies, but they do not prove it, and never have. It is easy to make such claims, but another thing to sustain evidence. It is claimed that the South Norwalk, Conn., plant is an illustration of what can be done under municipal ownership. The question is whether the reports sent out regarding this plant are sustained by the facts. There are many reasons for believing that they are made for the purpose of bolstering up the enterprise. February 28, 1893, the Lighting Commission reported that they had expended $22,452.97 of the $22,500 appropriated and had on hand $48.03. They claimed that they had not only installed the plant, but had operated it to that date with the money that the city had appropriated for its installation, and in addition they had on hand a stock of working materials and supplies sufficient for months. In this report they credit themselves with paying $1040.50 for labor; on October 12, 1893, they made another report in which they state that the wages paid between October 13, 1892, and February 28, 1893, were $895, notwithstanding that they claimed in their first report that they had paid $1040.50 for this same period. In the second report is an item of $412.99 paid an electric company and charged to construction, but the inventory does not show any new apparatus installed. Why was it necessary to expend $412.99 for reconstruction in the station after running only six months? Did they not burn out an armature and adopt the usual plan of charging to construction? To reduce operating expenses they deducted supplies on hand. If they had used supplies during the year in running the lights, whatever amount had been used during that time should be added to the other expenses, but the idea of deducting supplies on hand which had not been charged to that account, or used, in order to make the cost of lights appear less, is certainly an original one with this committee. In the report of February, 1893, they state that the lamps are 1600 cp, in one made October, 1893, they say they are 1400 cp, while the October, 1896, reports claim they are 1200 cp. Which of these reports is correct? In the 1896 report they claim that there was unexpended at the starting up of the plant $2500, while the February, 1893, report says they only had $48.03 unexpended. If, as they claimed, they only expended $1657.46 operating the plant, and had $2500 on hand when they completed the installation, what was done with the balance of $842.54? A test made by an expert of their boilers disclosed the fact that only 37 per cent. of the heat of the coal was utilized, that is, they were losing 63 per cent. of all the coal burned under their boilers. With their boilers giving an efficiency of only 37 per cent., they pretend that they can furnish lights at about half the price it costs private companies to produce the same light. The chairman of the Lighting Committee published a statement that the cost of lights under municipal ownership was 20¾ cents per night, while the private company charged for 81 800-cp lamps, burned on moonlight schedule, 22 cents per night. If burned as he says, 311 nights, at 22 cents per lamp, for eighty-one lights, the cost would be $5542.02 per year. By reference to the City Clerk's report for that year we find that the total

amount paid out for lights to the private company was $4903.72, being a little over 19 cents per night if burned as he claimed. Why in this comparison did he suppress the fact that the private company furnished the 800-cp lamps from dusk until 1 A. M. during twenty-six nights each month for four and one-half months of the year, and during the remaining seven and one-half months burned them from dusk until 5 in the morning every night, giving about 80,000 hours of service which he has not shown or credited to the private company in this comparison—a fair sample of the comparison usually made by advocates of municipal ownership. If he had given the facts he would have shown by his own comparison that the price paid the private company was less than it cost the city to produce them in their own plant. This committee state that lamps only cost $58.96, including interest and depreciation. Upon an examination of their business for the year 1896 we find that the operating expenses were.....$4382.82
Interest at 4 per cent..... 900.00
Depreciation at 8 per cent..... 1800.00
Insurance 150.00
Taxes 150.00

Total $7382.83

being $74.57 per lamp for a 1200 cp burning on moonlight schedule. In the above calculation the following items were not considered as part of the cost of lights: $488.96, which they added to their real estate after a year's use and without any increase in their property; $359.56 increase in value of tools in the same way; $414.24 for station sewer, which was charged to the sewer account of the city, instead of lighting account, and the expense of a new cable under the river to replace one supposed to have been burned out and the cost of which was charged to extension of plant instead of repairs, where it belonged. Neither does it show the $842.54 which has disappeared if their statement in the 1896 report is correct or the costs and attorney's fees in the two suits of about $20,000, which the city have upon their hands over this electric light plant, and which even if they should win both are making and will continue to make thousands of dollars expense for the taxpayers. Charging the expenses up to legal, sewer, and other departments does not relieve the taxpayers. It simply gives the committee an opportunity for claiming that the lights are cheap.

Detroit, Mich., has been quoted as the model municipal plant of the United States. The first report of the Lighting Committee gives the cost of operating for one year, interest added, at $84.70 per lamp. When depreciation (at 8 per cent.), with insurance and taxes amounting to $27.30 per lamp is added the cost is $112 per year. This is the record with a new plant and business confined to the central portion of the city. What will it be when the plant is worn and repairs increase and the lines have to be extended to the city's limits, and the political pull which has already shown its hand in the management has time to develop and organize its forces for the next election?

Hamilton, Ohio, had a Mayor who was an advocate of municipal ownership, and in his report he said "he had made an investigation, and in some cases the figures showed that the city could get its lights for nothing, making enough out of the profits on general electric lighting business to provide all the arc lights required free of expense." This Mayor's statement is the visionary and theoretical part of the plan. What does the practical part or real experience show, after the plant has been established. In 1894 the city purchased gas works costing $100,000. In 1895 they installed an electric light plant costing $100,000. All of this money was raised by issuing bonds of the city. The plan has proved a failure, and to prevent shutting down the plant and leaving the city in darkness they borrowed $6000 to pay the running expenses. The City Clerk says: "We are deluded in the belief that we have cheap gas and electric lights, but we must add to these luxuries the fact that we have raised the rate of municipal taxation until it has become burdensome. We are taxed to pay the interest on the bonds as well as to provide for their redemption, and we are also taxed for the purpose of lighting the city, which is nothing more than double taxation. While the tax levy is up to the limit it barely pays the interest charges, with no bonds falling due. Hamilton is being devoured whole by its interest charges. During the coming year the interest owing by the city will amount to the sum of $43,035, bonds falling due $48,000, a total of $91,125, or nearly 90 per cent. of the entire revenue of the city." This is the practical application of the system. Do the taxpayers in other cities wish to adopt the plan and place themselves in the same position?

The taxpayers of Springfield, Ill., were beguiled into adopting a plan which they were told could be carried out so that they would have arc lights at a cost of only $60 per year, and at the end of five years would own the entire plant, paid for out of the surplus or profits. After this system had been in operation for eighteen months the Mayor employed experts to figure out the profits. In their report to him they say that the plant at that time had cost $99,379, while the lights cost $93.64 per lamp per year. The local company offered to furnish the lights before the city plant was installed for $90 per lamp per year, the city assuming no liability. The agreement provides that when the surplus amounts to as much as the plant cost, the city will be entitled to take the entire plant. There is no assurance that the business will stand still; on the contrary, the contract expressly provides for a constant increase which will indefinitely delay the maturing of the city's option. The contractors can extend the business without limit, and the city must furnish the apparatus necessary for the extension. When the plan was adopted the entire cost was not to exceed $60,000, but it already amounts to $99,379. The Mayor's experts advised him that with the long and constant wear and tear to which this class of machinery is subjected, the depreciation was not less than 10 per cent., and that the city should obtain possession as soon as possible, especially as there has already been expended $16,464 for commercial lighting apparatus, and this amount was steadily increasing. Under the city's charter it is prohibited from doing a commercial lighting business, and therefore will have no use for this apparatus, and will have to dispose of it at any price that it can obtain, thus sinking thousands of dollars on this item. They have installed over 100 arc lights in front of stores to be used only Saturday nights, and from which the entire receipts will not pay the interest on the cost of such installation. It being the taxpayers' money, it is not necessary to economize or restrict expenditures. If they make no more extensions and do not increase the expenses it will require over twelve years from the present time to pay for the present cost of plant. Then the taxpayers have invested $99,000 in a plant which has run fourteen years, and is an old, worn-out, antiquated affair. Here we have the practical result of the wonderful plan proposed by the advocates of municipal ownership, whereby a city can obtain something for nothing. The city practically furnishes a plant complete, pays for all extensions, all taxes, attorneys' fees, insurance and depreciation, and then agrees to pay $60 per year per lamp to the contractors for running the plant. There are hundreds of private companies who would be glad to contract with cities upon such a basis.

Des Moines, Ia., is being worked on the same plan, and the taxpayers there will have a chance if it is adopted of voting taxes to their hearts' content. An article was published by an advocate of municipal ownership in which the statement was made that the entire cost of an arc light of 2000 cp in Swanton, Vt., was only $10 per year. This malicious statement without a particle of proof to sustain it has been promulgated and distributed as a sample of what may be accomplished by a municipality. Upon an examination of their report ending March, 1897, we find that the plant has cost $42,707.00. The operating expenses, interest, insurance, taxes and depreciation (at 5 per cent.) amount to $7846.18 per year, while the total income was $4964.71, leaving a balance of $2881.47 as the cost of twenty arc lights per year, being $144.07 per lamp, using water power. Their indebtedness in 1895 was $38,866; in 1896, $41,964, and in 1897, $42,767, while repairs in 1895 were $341; in 1896, $591, and in 1897, $732, showing a steady increase of indebtedness as well as repairs. They voted a tax of 0.30 per cent., one half of it to be used in paying the expenses of the electric light plant, and the other half for all the other expenses of the village, including streets, sidewalks, sewers, water, fire department and police. This shows that the electric lights, instead of costing $10 per lamp per year, require one-half of the entire money received by the tax levy. Whenever one of the advocates of municipal ownership finds himself stranded he immediately flies to Glasgow for relief, and usually proclaims that there the profits from municipal ownership pay the entire expenses of the city, and that no taxes are collected. The Lord Provost of Glasgow brands this statement as false. "The Glasgow Street Railroad, owned by the city, has a track five and one-half miles long and charges six cents fare, and pays its conductors and motormen from 85 cents to $1.12

per day of ten hours." The West End Road, in Boston, Mass., managed by a private company, carries passengers sixteen miles for five cents, and pays its conductors and motormen $2.25 per day of ten hours, and for five cents carries a passenger three times as many miles as Glasgow. Would it not pay some of the labor organizations who are advocating municipal ownership to compare wages paid by the municipal plant and those paid by the private company. Are they advocating the system because they want wages made $1 per day instead of $2.25? If the system of municipal ownership is so profitable and such a saving when compared with the price charged by private companies, why have so many cities abandoned it after a thorough trial and a loss of thousands of dollars?

Why did Xenia, Ohio, sell a plant that cost $35,000 for $10,000, and Gravesend, L. I., sell their plant costing $120,000 for $31,000? At Michigan City one costing $10,000 sold for $2500. The Moline, Ill., plant cost $15,000, and sold for $8000. At St. Joseph, Mo., the plant costing $90,000 sold for $60,000. Scores of others have found that they could not produce the lights as cheaply as a private company, and therefore abandoned their plants and made contracts for their lights. The nine municipal plants in Massachusetts have 1159 customers who take commercial lights; over 200,000 people are taxed to furnish 1159 of their citizens with the luxury of commercial electric lights. If all the companies doing business in Massachusetts were controlled by municipalities, over 10,000,000 of the citizens would be taxed in order that 2458 of their number could be given commercial arc lights, while they are all able and should pay a private company for such luxuries. Under municipal ownership, the man who cannot afford an electric light for his own use is taxed to make up the loss caused by furnishing commercial lights for his neighbor at less than cost. In the costs given by managers of municipal plants no record is ever made of accidents or damages paid. Jacksonville, Fla., gave a glowing account of profits, and claimed that they had run the plant for $620 less than a private company charged for the lights. A short time after that statement was published a judgment for $1500 was entered against the city in favor of a man injured by falling into a hole dug for a lamp pole, which could not be seen on account of the lights furnished by the city plant being out. How much will there be left of the $620 profits after this judgment of $1500 is paid? Private companies have to guarantee cities against all such accidents when they furnish the lights. They also have to suffer the loss caused by storms, and in St. Louis one storm alone cost the companies over half a million dollars. We are told that politics are never, or hardly ever, generated in a municipal plant. The Massachusetts Legislature gave a hearing recently regarding the Middleboro plant, in which one of the managers was removed so that one of the commissioners could have the office, and it was by this commissioner's own vote that he elected himself as such manager. An ex-member of the board stated to the Legislative Committee that the plant was run more in the interest of politics than in the interest of the town, and that this manager who elected himself had never had any experience in running a plant, and knew nothing about electricity. This is one of the plants that the advocates of municipal ownership are advertising as a great success and an immense saving to the taxpayers. The reason why such a man can act as manager is that a municipal plant is run for politics and not for electricity, and therefore no electrician is required. In Jackson, Ohio, they claim that the elections come so often that the manager cannot become acquainted with the work before another election, when his successor is appointed by the winning party. In Grand Haven, Mich., the Board of Aldermen and the Council were involved in a fight simply because one of the Aldermen had a relative who had labored hard during the election, and was given the berth of electrician as a reward. It is under this style of management and business that we are told that it is cheaper and more beneficial to the taxpayer than a contract with a private company for a stated amount and free from all liabilities and contingencies. The city of Grand Rapids, Mich., is being worked in the interest of municipal ownership notwithstanding the city is already burdened with heavy taxes (and 2500 places are advertised to be sold for taxes); they want to induce the taxpayers to issue bonds for $125,000 to purchase a plant. There are several private companies in the city and sharp competition. An offer was made by one of these companies to duplicate the prices obtained by the municipal plant at Detroit, the private company furnishing all capital and assuming all liability. What can the taxpayers of Grand Rapids expect to gain by municipal ownership when they can avail themselves of such an offer?—a chance to secure lights at the same price as it costs Detroit to produce them in what every advocate of municipal ownership claims is the model plant of the United States? One of the Aldermen claims that the municipal plant in Detroit has saved the city thousands of dollars, yet when the local company in his own city offer to run the lights at the same price it cost the Detroit plant, the city to have no bonds or liability, he rushed into print with an eulogy on municipal ownership of plants without having a particle of practical experience in the business or knowledge of its requirements. He tells the people that they can produce the lights for about half the price offered by the private company. He refers to Lansing, Mich., as a success, but the Mayor of that city, after an actual experience, does not seem to take the same glowing view of the matter. The Mayor says: "The Lansing plant has already cost $106,000, and is far from being worth any such amount." He claims that the city is not selling to private consumers any such quantity or value of light as it charges them for, and in thus doing business the city is really engaged in wholesale larceny. "We cannot hope to sell the plant for anything like its cost." Quite a different view, after actual experience, from the visionary theory of the Alderman from Grand Rapids. This same wild plan was talked when Hamilton, Ohio, was induced to adopt the system, men advocating the investment of thousands of dollars of the public funds in a business of which they have not the least conception of the details or intricacies, and which requires the most careful and skillful management of any in the world. Why did not this Alderman refer to the city of Marquette in his own State? The Mayor of that city published a statement that the profits from the municipal plant were $5000 a year, and that in a very short time the profits of the plant would pay all the expenses of the city, and no taxes would be levied. It was by means of such bombastic statements that the taxpayers were induced to authorize the increase in plant and dam. The Mayor and two of the Aldermen, unfamiliar with the business, took charge of the construction, and as a result costly and deplorable blunders were made. Thousands of dollars were spent on construction and in experimenting, and carrying out these wild theories, which were all right until put to a test, when the whole affair gave way. Good judges estimate the loss to taxpayers at $50,000—the result of a "pull" and political management of a business enterprise. It is useless for anyone to claim that cities are managed in a business-like manner, or even honestly at the present time, while you hear the cry from nearly every State between the Atlantic and the Golden Gate for relief from the corruption and mismanagement of municipalities.

American Association for the Advancement of Science.

A preliminary programme of the proceedings of the Detroit meeting of the American Association for the Advancement of Science is to be issued by each of the sections before the middle of June. It is expected that the programme for Section B (physics) will include a number of electrical papers of especial interest, as it is becoming more and more customary for electricians to attend this meeting. Brief abstracts of papers to be presented before this section should be forwarded to its secretary, Dr. Frederick Bedell, Ithaca, N. Y., at the earliest possible date.

Transmutation of Substances.

The well-known English physicist, Prof. George F. FitzGerald, in discussing Prof. J. J. Thomson's hypothesis that atoms may be dissociated by means of cathode rays, states that if the re-aggregation of these corpuscles, or subdivided atoms, depends upon electromagnetic and other conditions under control, we are within measurable distance of the dreams of the alchemists, and are in the presence of a method of transmuting one substance into another. He considers this hypothesis by no means impossible.

Orange Electricity.

Mr. Trotter, in a foreign scientific journal, shows that a fairly strong current can be obtained by sticking a steel knife and a silver fork into an orange.

The Telephone Repeater.—III.

BY F. JARVIS PATTEN.

I will now describe a few new methods of my own, nowhere described in books or patents to my knowledge.

One that puzzled me for a long time and tried my patience severely I styled the "Ferro-Carbon Microphone," and perhaps I was more disappointed at its failure because it had such a pretty name. Its general features are shown in Fig. 16. I had tired of getting a material kick out of the receiver diaphragm, and so went at it this way.

The part *G* represents a small glass tube with a rubber plug closing each end. A telephone coil *C* encircles its middle part. The tube is very loosely filled with a mixture of powdered iron and

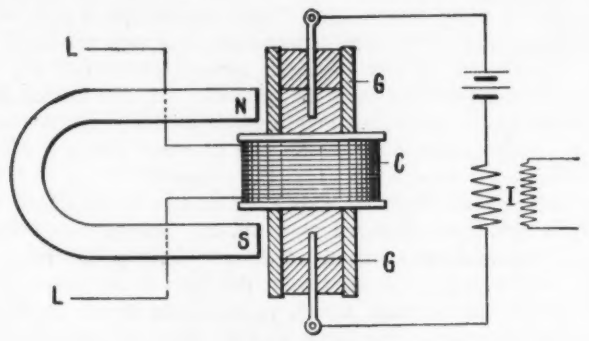


Fig. 16.

powdered carbon particles, and this material is made a part of the secondary circuit which goes in through one plug and out at the other, the ferro-carbon mixture being a connecting bridge between the ingoing and outgoing terminals.

To assist the effect a small permanent magnet was laid with its poles against the outside of the tube, its purpose being to hold the iron filings of the mixture under a slight magnetic strain; it did, in fact, suspend the iron grains with the grains of carbon intermixed beween them in space between its poles. This part worked beautifully. Now, of course, when the telephone current came through the coil it would disturb this magnetization slightly, according to the intensity of its variation, etc., and the little carbon and iron particles, by a minute change in their relations, would correspondingly alter the resistance of the secondary circuit and repeat, but this part did not work. Why?

I think if it were known when those earlier forms, using what I call the "diaphragm kick" to actually move something, were designed, that the receiver diaphragm only moves 0.0000004—four ten-millionths of an inch, much time and money would have been saved. I am informed it has been recently determined that that is the measure of its "kick." So we may conclude that the only safe line of work is to leave all mechanism of any kind absolutely out of contact with a diaphragm of the receiver, for no device that has it will ever repeat.

Going, therefore, to the opposite extreme, what is wrong with

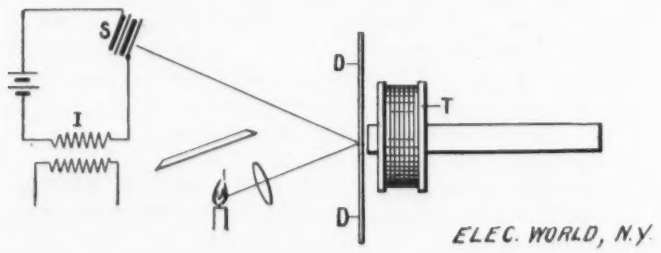


Fig. 17.

the machine shown in Fig. 17, which I style the "photophone repeater"? This almost explains itself. Any ordinary 'phone receiver is provided with a diaphragm having a highly polished silvered surface, against which a beam of light is thrown from the source *L*. The reflected beam is thrown on a selenium cell *S* at some distance from the diaphragm. The selenium cell is a part of the secondary circuit. Now, as the receiving diaphragm vibrates the reflected beam is correspondingly moved about, partially off or entirely off the selenium cell, acording to the magnitude of the diaphragm vibration, thus varying the secondary circuit in a manner corresponding to the diaphragm movement

This scheme certainly leaves out all the clumsy things incident to the failures previously described. Besides this, the lever used, which is the reflected ray of light, is not only imponderable, but it also magnifies enormously the diaphragm movements, a feature greatly to be desired.

While working with the mercury and floating ball transmitter previously described, I conceived the idea of making a mercury transmitter, which at the same time would have the metallic fluid

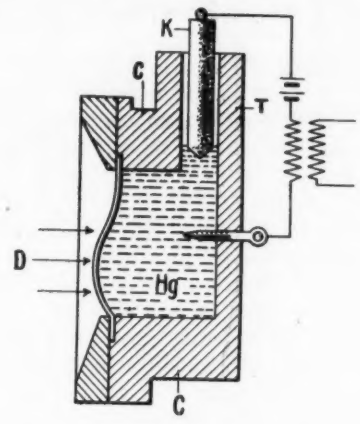


Fig. 18.

entirely enclosed and in which its own weight would serve to steady it and prevent the incessant surface vibration before mentioned, which was constantly going on.

My efforts led to the production of the mercury transmitter shown in Figs. 18, and 19, which is of interest only to show how I arrived at the best practical telephone repeater I have heard of and the only one out of sixty-odd that I ever heard repeat well.

In the figures 18 is a sectional view and 19 is a front elevation, in both *C* represents a box or diaphragm case, circular in form, about the same size and similar to those used in many forms of transmitters. The circular cavity, an inch and a half in diameter, say, and half an inch deep, was closed at the front by a thin membrane of soft rubber stretched across it, indicated at *D*. At the top of the cavity is a cylindrical vent or tube communicating directly with the exterior, both tube and box being made of insulating material. A cavity was then filled completely with mercury to a point about a quarter way up the tube, the weight of

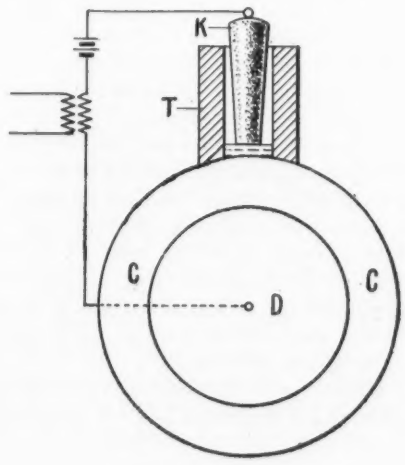


Fig. 19.

which, of course, made the rubber membrane over the front of the box swell out as indicated in Fig. 18. The only remaining part of this transmitter was a slender pencil of carbon, *K*, considerably smaller in diameter than the tube, and this was simply dropped into the latter until it floated slightly immersed in the mercury.

This was an excellent transmitter, and there was no roaring, due to the shaking of the mercury, as in the other form described.

Now, this odd transmitter embodied a principle of hydraulics not, I think, heretofore introduced into telephone practice, which

is that of the "hydrostatic paradox" of the school philosophies—thus whatever motion, however slight, the rubber membrane might receive from the impact of sound waves, the movement was necessarily multiplied in the tube in proportion as the cross-sectional area of the tube was smaller than the cross-sectional area of the circular box, Thus, if the tube were of unit diameter and the box had a diameter of eight units, then the motion in the tube would be approximately sixty-four times the motion of the diaphragm. It is the principle of the hydrostatic lever. In one I made, of about these proportions, the motion of the diaphragm was so multiplied that the movements of the carbon pencil were discernible to the eye. Here at last was a multiplying lever without mechan-

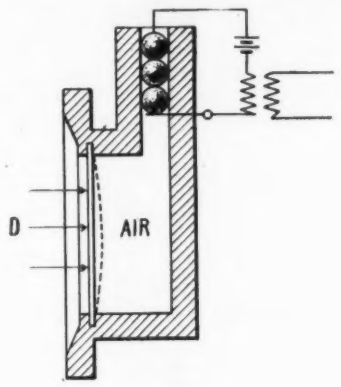


FIG. 20.

ism, but how to apply it was the question, as the most trifling weight of mercury would dampen the motion of any receiver diaphragm.

The next step indicated in Fig. 20 was a surprise, as I had no serious expectation that it would work. I took the mercury out altogether and stretched a thin soft rubber membrane taut across the front of the casing. The carbon pencil was removed and a few light carbon balls (one-fourth inch diameter) were substituted for it, and to prevent these falling down through the tube into the box a single bare wire was passed diametrically across the tube near its lower end, the projecting end of which served as one terminal, and a slender thread of wire soldered to the upper carbon ball was the other.

This transmitter worked just as well as the previous mercury system, the troublesome weight and trembling of the mercury were

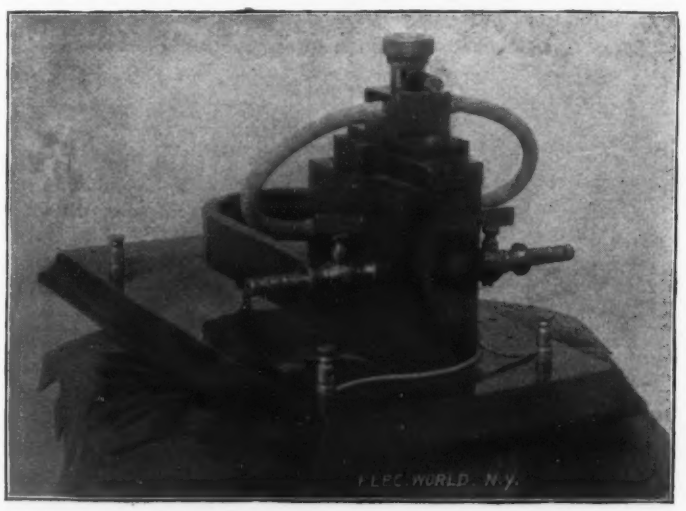


FIG. 21.

both gotten rid of, while the multiplying action of the hydrostatic lever was still retained.

This looked good enough to try as a repeater, for here again was all the required mechanism without appreciable ponderability or friction or any fixed rate of movement or vibration, the bane of all electro-mechanical solutions of the repeater problem. A good talking repeater which I have made in several forms is simply an embodiment of the foregoing principles. Fig. 21 is a perspective and Fig. 22 a vertical elevation in section of such an instrument.

The receiving telephone diaphragm *G* is enclosed in an air-tight box, to which the stop cocks *K* and *K* have access to the two compartments thereof, separated by the diaphragm, so that both are air tight.

The chamber on one side of the diaphragm communicates with the closed air chamber above, in which the carbon balls *B* are placed. The upper and lower parts of this tube or air chamber

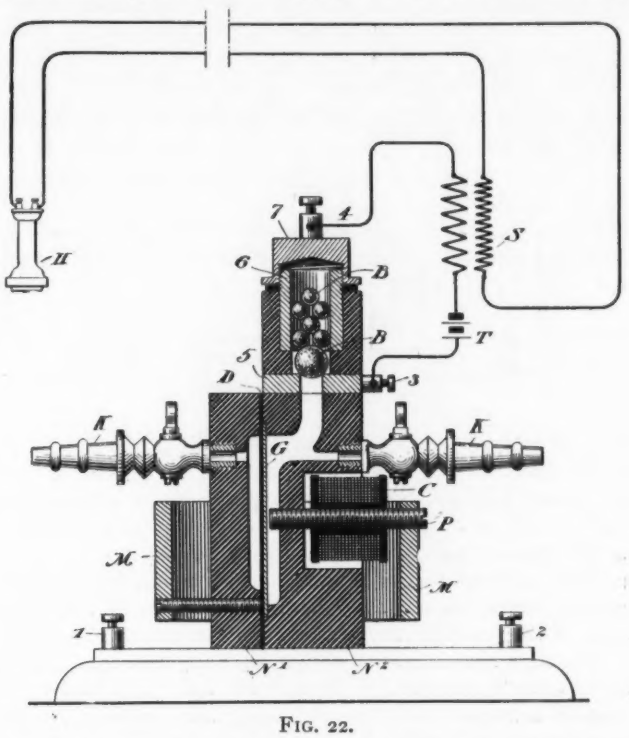


FIG. 22.

are metallic, while an intermediate portion is of insulating material, the box and all except the metallic parts being of hard rubber. The metallic ends of the tube are therefore the terminals of the repeating circuit, including the battery *T*, the carbon balls *B*, and induction coil *S*, thus leaving the carbon balls free from disturbing connections of any kind.

By means of the stop cocks *K* the air in the diaphragm chamber can be compressed to any desired degree, it being only important that the compression should be alike on both sides of the diaphragm.

Considering now for a moment the question of telephoning in either direction over the same line. It seems to me almost absurd to suppose that if telephone repetition should come into extended use that there would not at once arise as many solutions of doing this for telephony as there have for telegraphy, until now a new

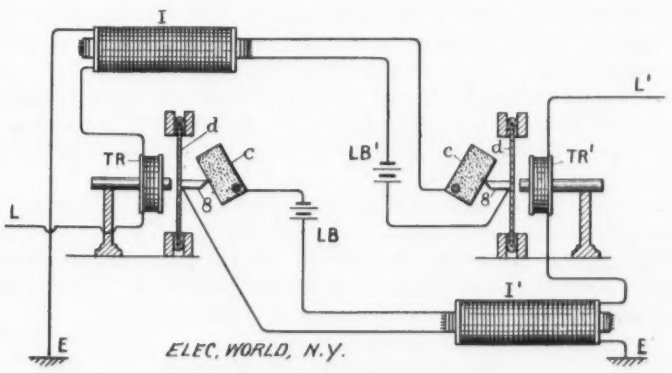


FIG. 23.

telegraph repeater is regarded as an old joke. The trouble is that telephone repeaters that will repeat and do it well, have not been made. There will be use enough for them when they shall have become something more than mere figments of the inventor's intellect, mere iridescent dreams. Of course, as repeaters are a comparatively meagre and scarce article among patent records, so these repeating systems for working both ways on the same circuit are much scarcer still.

In my search I found one that looks so good it is worth giving at the risk of burdening this article. It is very similar to an ordi-

nary telegraph repeater, which was doubtless its grandparent. This system is all right in principle, so far as the circuits are concerned. I venture the opinion it will repeat both ways on one circuit if it will repeat one way, and the only objection to it I can see is the microphone repeater used, which is a member of the large family of failures that aim to take up the diaphragm movement by mechanical contact and action. This feature remedied, the system will work either way equally well.

I now come to that class of repeaters such as one by Edison, referred to by Mr. Lockwood as one "that repeats and does it well." The system is shown in Fig. 24, and is so similar to half a dozen others I find in the patent records that they are scarcely distinguishable one from the other.

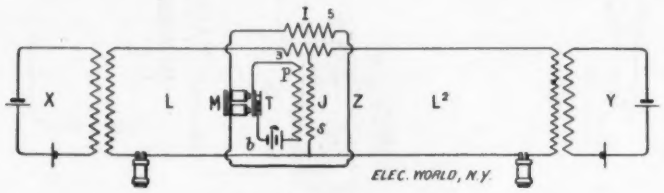


Fig. 24.

This sort of system appears to me something in the light of begging the question. It is not a repeater in my definition of the term. In fact I do not consider it a repeater at all, although I admit speech will be distinctly heard the other side of the central or repeating station; but so will the speech be heard there just the same if we take the alleged repeater out of the central station and throw the central station away altogether. This is a system or solution of the problem that dodges the issue entirely.

All this class have a central station repeating transmitter, *T*, that is never described in detail. It is some kind of a magnet with mechanical armature of the failure family that never in the world was known to say a word, to say nothing of repeating a word to a second line; remove this so-called repeater, and you will get your speech at the terminal station just as well without it, because it was never a necessary addition to the system. If the first and second lines be connected in one circuit all the time, it does not constitute such a system as I defined of retransmitting the speech received at the end of a first line to an independent second line.

Mr. Lockwood, in quoting my definition of a repeater or repeating system, splits my definition in two somewhere near the middle and then takes advantage of the split, which is not altogether fair.

To conclude, it is my opinion that a good commercial repeater when found will have a field of usefulness hardly second to that of the telephone itself. To be sure we can telephone straight away very great distances; but at what cost? A heavy copper double circuit line that costs ten times as much for installation as an ordinary telegraph line, which is the reason why there is only one telephone line to Chicago, nearly the limit of distance, whereas Omaha, Denver, Salt Lake and San Francisco are "not in it."

If we had a good repeater we could telephone over ordinary telegraph lines, and enough of them are in existence to join them up in pairs to form complete metallic circuits, and have plenty to spare for telegraph work.

Again, look at the miserably out-of-date condition of ocean telegraphy to-day as compared with land telegraphy, to say nothing of telephony. A really out-and-out good repeater would make ocean telephony possible, and with such a prize to win I can never persuade myself that electrical invention is dead.

Electricity on Steam Roads.

It is stated that an agreement has just been concluded by which the trains through the Mt. Cenis tunnel are to be operated electrically, the intention being to extend the system ultimately as far down as Turin, Italy.

A Condenser for Alternating Currents.

The physicist Threlfall found that a condenser made with paper, saturated with a mixture of vaseline and hard paraffine, did not heat when used with alternating currents.

Progress of the Enclosed Arc Lamp.

BY LOUIS B. MARKS.

Just three years have passed since the keynote of the art of enclosed arc-lighting, as now universally practiced, was sounded in a paper read before the National Electric Light Association in convention at Washington, D. C. Whereas before that time all attempts to introduce lamps of this type commercially had been unsuccessful, to-day the enclosed arc lamp is an important factor in electric illumination the world over. When we consider the brief interval of time that bridges this gap between dire failure and pronounced commercial success, we begin to realize the phenomenal progress of the enclosed arc.

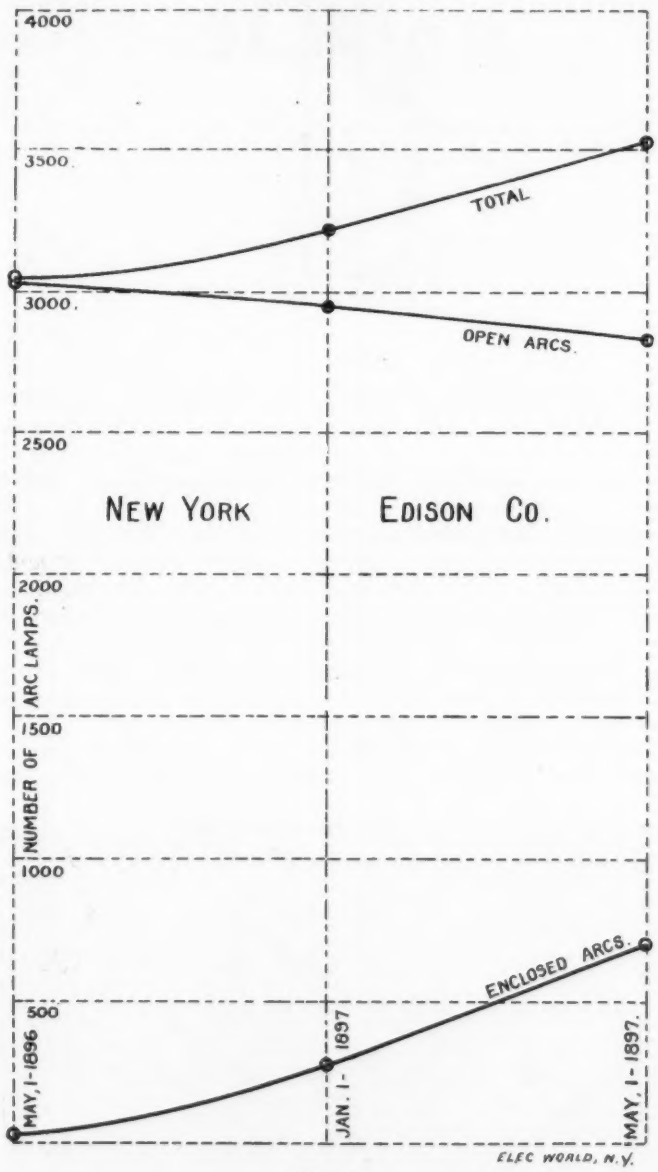


Fig. 1.

It will not be necessary to comment here on the advantages of the lamp; suffice it to say the enclosed arc has been adopted by many of the largest central stations in the country, and has found its way into the vast majority of the isolated plants installed during the past year. The enclosed lamps, besides replacing many of the open arcs that were in service, are also extensively used in a variety of places where heretofore the open arcs have not met the requirements. Although the open lamp is thus gradually giving way to the enclosed, the process is more than one of simple substitution; the records show that the total number of arc lamps in use is increasing very rapidly. The figures indicating the relative number of open and enclosed arc lamps at intervals during the past year on the circuits of almost any large central station in the country will give evidence of the remarkable growth in the number of enclosed arcs, and the invariable diminution in use of the open lamps.

The record of development on the circuits of the Edison Electric Illuminating Company of New York City is typical of the change that is now taking place in many of the central stations, and shows the rapid progress of the enclosed arc during the past year. On May 1, 1896, the New York Edison Company had over 3000 arc lamps on its circuits and only about 25 enclosed arcs; on May 1, 1897, the number of open arcs on its circuits had decreased by about 200, and the number of enclosed arcs increased by about 675. These figures refer to the central station plant of the Edison Company, and do not include the auxiliary, or "breakdown" service.

Number of Arc Lamps on Circuits of Edison Electric Illuminating Company, New York:

	Open Arcs.	Enclosed Arcs.	Total.
May 1, 1896	3033	25 (about)	3058
January 1, 1897	2945	280 "	3225
May 1, 1897	2831	700 "	3531

It will be seen that although there was a marked falling off in the number of open lamps used, the total number of arcs in 1897 increased nearly 500 over 1896. All of the enclosed lamps on the circuits of the New York Edison Company are used for indoor illumination, but the company has recently adopted the enclosed arc for outdoor lighting as well, and will soon install about 250 of these lamps for street lighting in New York City. This number, together with the additional in-door lamps already contracted for, but not yet in service, will increase the total figure to about 1200 enclosed arc lamps connected to its circuits in a little over a year—a record probably unparalleled in the history of arc-lamp development.

The inroads of the enclosed arc upon the open are perhaps more strikingly shown in the records of the Edison Electric Illuminating Company of Boston than in those of any other central station. On May 1, 1895, the Boston Edison Company had over 800 open arc lamps on its circuits and no enclosed arcs; on May 1, 1897, the number of open lamps had fallen to 471, and 957 enclosed arcs had been installed.

Number of Arc Lamps on Circuits of Edison Electric Illuminating Company, Boston:

	Open Arcs.	Enclosed Arcs.	Total.
May 1, 1895	827	0	827
May 1, 1896	695	263	958
May 1, 1897	471	957	1428

Thus in spite of the large falling off in the number of open lamps, the total number of lamps on the circuits of the Boston Edison Company increased greatly, showing as in the previous case that the introduction of the enclosed arc gives an impetus to the development of the arc business.

In the case of the New York Edison Company the use of the enclosed arc lamp has up to the present time been confined solely to indoor or commercial circuits. The rapid growth in the number of enclosed arcs on the circuits of the Edison Electric Illuminating Company of Brooklyn, on the other hand, has been due chiefly to the success of the lamp for purposes of street, or outdoor illumination. On May 1, 1895, the Brooklyn Edison Company had 3236 open arc lamps on its circuits and no enclosed arcs; on May 1, 1897, the number of open lamps had fallen to 3058, and 733 enclosed arcs had been installed.

Number of Arc Lamps on Circuits of Edison Electric Illuminating Company, Brooklyn:

	Open Arcs.	Enclosed Arcs.	Total.
May 1, 1895	3236	0	3236
May 1, 1896	3294	377	3671
May 1, 1897	3058	733	3791

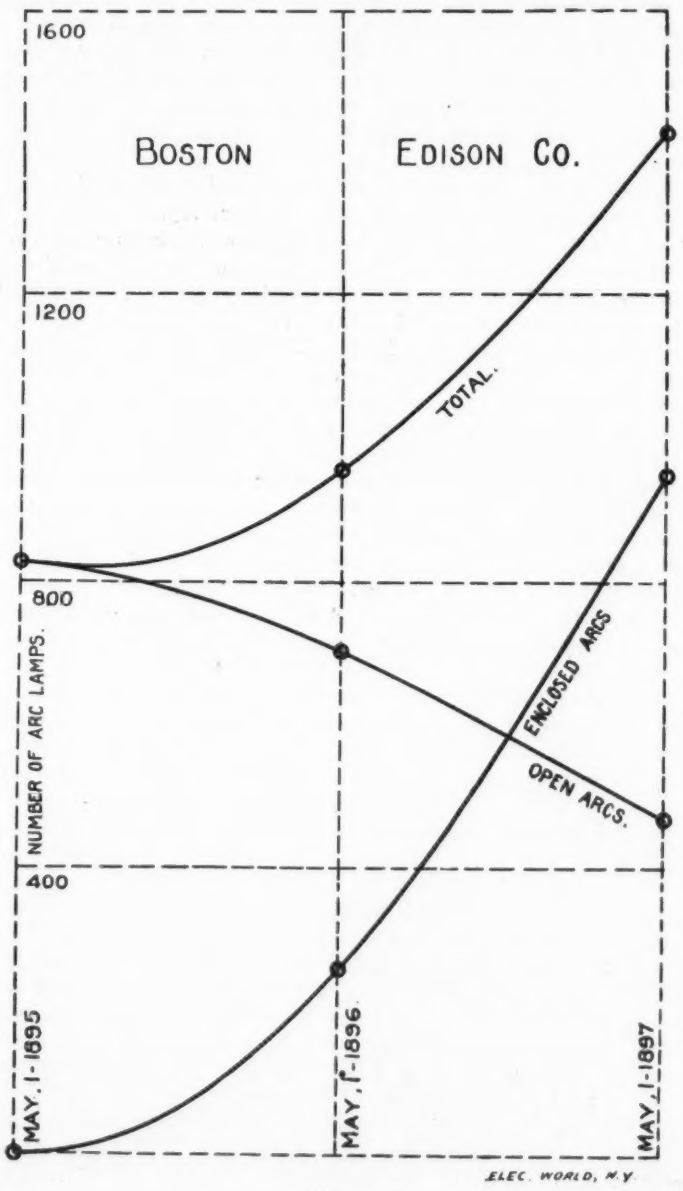


FIG. 2.

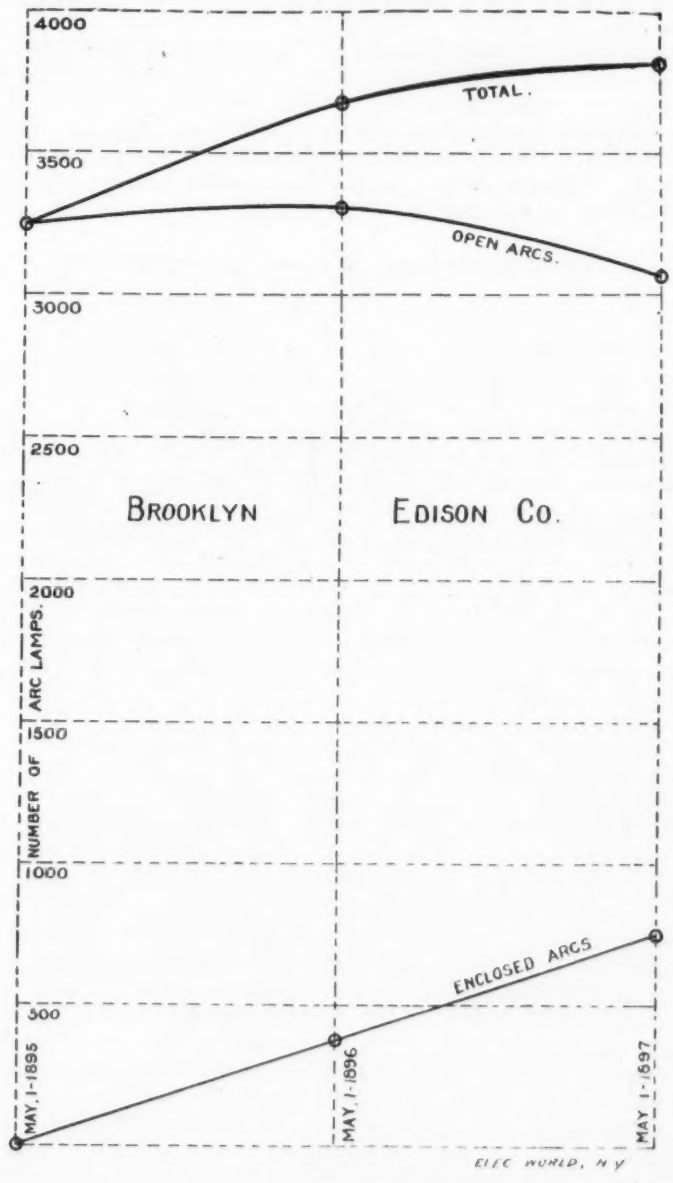


FIG. 3.

Of the enclosed arcs in service in Brooklyn on the Edison Company's circuits, about 450 are used for street lighting; these lamps in most cases have replaced open arcs.

The three instances of central stations cited come under the heading of low-tension plants. Although thus far the principal development of enclosed arc lamps has taken place on low-tension (constant potential) direct-current circuits, the application to series circuits is now being pushed along the lines laid down by the writer a few years ago. Likewise the alternating current enclosed arc lamp, although far from satisfactory, is gradually making its way on commercial circuits. The progress of the enclosed arc abroad during the past year has marked an epoch in the exploitation of American inventions on the other side of the water.

What the future may have in store for us it is idle to speculate. A glance at the curves which are given herewith may, however, convey a fair idea of the trend of arc lamp development. In these curves no attempt has been made to demonstrate the exact relative usages from month to month of the two types of lamps; but the story of the progress of the enclosed arc is told in a most impressive way.

It will be noted that the open arc curve of the Boston Edison Company, if prolonged, would reach the zero point before the end of two years from May 1, 1897. The decline of the open lamp is in general not so marked, as is shown by the other curves. Whether the open arcs will eventually be replaced for all purposes by enclosed arcs remains to be seen; but from present indications there will continue to be a field for both types of lamps.

A Profitable Day Load for a Large Central Station.

BY C. H. WILMERDING.

The statement is often heard that an electric light station, having a night-lighting load which utilizes the capacity of its equipment during the natural lighting hours, beginning at dusk, can largely increase its earnings without increasing its investment by acquiring a day load in motors or in light. This is true as far as it applies to an additional income, but it is not true that such results can be obtained without additional plant investment. The additional load thus taken on must increase the maximum station load in at least as great a proportion as the previous ratio of maximum to connected load, for the day load and the night load will overlap during the winter months, and each will be at its maximum at the time they come together. The plant investment must therefore be increased in the same proportion as the maximum load. The fact that by the addition of the day load a certain part of the generating machinery will be in use during a greater number of hours each day does not increase the interest-earning capacity of the plant, unless the ratio of twenty-four average to maximum is greater than the same ratio was under conditions of night run only, except in so far as the operating cost per unit is reduced by a greater proportional increase in output than in expenses. The extent of this reduction would, in a measure, be determined by the volume of added business. With the exception of one or two accounts, general expenses would scarcely be affected by the increase. The accounting and supply department totals would be somewhat higher, and taxes and insurance would be raised, owing to increased investment, but all other general charges would remain practically constant. In the station expenses, superintendence and maintenance of building would be unchanged, and outside there would be but a slight change in cost of maintaining the distributing system. In these items, therefore, the increased load would bring about a direct saving in cost per unit. In fuel and water, if water must be purchased, the increased cost is not directly proportional to the increased output, as the necessity for banking fires through the day entails, on acount of radiation, an appreciable consumption of both. In these then there would also be a slight advantage over the previous average cost per unit, and if the volume of the added load be such that the station labor, machinery repairs, and other items which vary directly with the output, are increased no more in the aggregate than the sum of the savings in the constant items, the day load would be as profitable per kilowatt hour as the night load, providing the selling price remained equal for both. But this last condition is one which is often lost sight of, and which in fact is very difficult to maintain. A very large proportion of day business is long burning. The mere fact that a customer requires light at all during the day indicates that he needs it, or a considerable portion of it, all day long, while most power users are practically steady consumers during working hours. This class of business is most desirable unquestionably, but the customer knows this as well as the station manager, and he often has but to make a few inquiries in regard to engines and dynamos to get a price from the service company which, although it pays him handsomely, is not altogether profitable to the corporation stockholder. The company can readily afford to make a very low rate for continuous service of this nature, but that rate should be fixed, not, as is often the case, by what the customer will pay, but by what the company can afford to sell for. On the other hand, the station manager often errs on the other side by maintaining nearly as high a rate for steady consumption as for intermittent and short daily service, thereby turning away considerable business, which would actually be extremely profitable to him. There is a happy medium which may readily be determined for comparatively large consumers of current, below which business is unprofitable, but to which prices can be reduced with perfect safety. To establish this rate, which varies for each plant with local conditions, it is necessary only to know the greatest load at any one time during the year, the drop and current losses between switchboard and consumer during this load, the interest charges, including dividends, the proper charge for depreciation on the whole system, the general expense charges, which may be assumed to be fixed, and the generating cost per kilowatt hour. The sum of the interest and dividend, depreciation and general expense charges for the year represents the total fixed charge. The greatest station load, less the copper and current losses at the time of that load, represents the maximum customer's demand, and the former divided by the latter, expressed in kilowatts, gives the fixed charge per annum for each kilowatt actually used at maximum load. The fact that this maximum seldom, if ever, bears a greater ratio to connected load than as one is to two, or 50 per cent., and in most plants is decidedly less than 50 per cent., might at first sight be taken as an indication that it would be proper to charge only this percentage of the fixed charge against each kilowatt capacity of connected load. This would be proper if it were possible to charge every consumer on the same basis, but if this system were applied to a consumer using but a small fraction of his connected lamps he would have to pay so exorbitant a price as to make electricity prohibitive, and as a matter of fact, it is only intended for application to cases where large consumption necessitates liberal reduction in rates, and as a guide as to how low a price can be made on that class of business. To illustrate: Assume a plant whose maximum load at the switchboard during the year was 4500 kilowatts. The capacity of generating machinery for such a load should be not less than 5000 kilowatts, allowing for all contingencies. Estimating the cost of station complete, including land, at $200 per kilowatt, and the cost of distributing system, services (underground), and meters at $150 per kilowatt on the same capacity, the plant investment would be $1,750,000, and, allowing for franchises, the purchase of competing plants, etc., the total investment might be taken at $2,500,000. Six per cent. on this sum for interest, and 5 per cent. on the cost of plant for depreciation would make the actual charge for these two items $237,500, or say $240,000. The general expense, including salaries of officers, accounting and office expenses, legal expense, collection, canvassing, taxes, insurance, and supply department, would probably not be less than $110,000 annually, so that the total fixed charge would be $350,000.

The maximum switchboard load having been 4500 kilowatts and the loss in distribution being taken under this full load at 25 per cent., the load as registered on customers' meters would be 3375 kilowatts, so that each kilowatt supplied at the maximum is chargeable with $103.73, or say $104 per annum, to cover the so-called fixed expenses, and each customer who uses all of his connected load, in lamps or in motors, at the time of maximum, should pay this sum per kilowatt capacity wired, as well as the actual cost of current delivered for each kilowatt hour supplied to him. This price, as stated before, would be prohibitive to the customer who takes service only for a short period at the time of maximum load, but public policy requires a company to supply all applicants who can pay for the service, and at rate, say, not exceeding 20 cents per kilowatt hour, so that the loss sustained through this class of business must be made up from the customers who use current more continuously. These short consumers strictly belong to the

night load, and would not affect the day profits one way or the other. The day customer will show, as a rule, a large daily average use of his connected load, and the assumption that he uses 100 per cent. of it at maximum is actually not far from the truth. Where he falls short of this percentage the excess which he is paying goes to carry his unprofitable neighbor. This may appear unjust, but in reality it is less so than the ordinary system of charges, by which a customer having twenty lamps connected and using them all ten hours a day, pays the same rate as the customer having 200 lamps connected and using them only one hour a day. The latter is the most profitable class of customer, and should pay the maximum rate, while the other is entitled to a liberal discount. The method here sugested of determining the rate which can profitably be made to such customers is based upon the length of time they use current or upon the proportion of their actual consumption to their greatest possible consumption.

If, for example, in the plant described, the average cost of generating and delivering a kilowatt hour is 5 cents, a customer having twenty lamps, or one kilowatt capacity connected, consumes 250 kilowatt hours in a month, his bill would be one-twelfth of $104, or $8.66, for fixed charges, plus $12.50, for generating cost, a total of $21.16, making a rate of 8.46 cents per kilowatt hour. If the same customer's meter showed a consumption of 125 kilowatt hours for the month, he would be charged $8.66 as before, for fixed charges, and $6.25 for generating cost, or $14.91, which would make his rate nearly 12 cents. In both cases he has paid the interest and depreciation on that portion of the investment necessary to supply him, his share of general expenses, and the cost of generating the current he has used. The rates per kilowatt of monthly consumption for each kilowatt capacity of connected load can readily be determined from a curve constructed from the data of each individual plant. The accompanying curve gives the

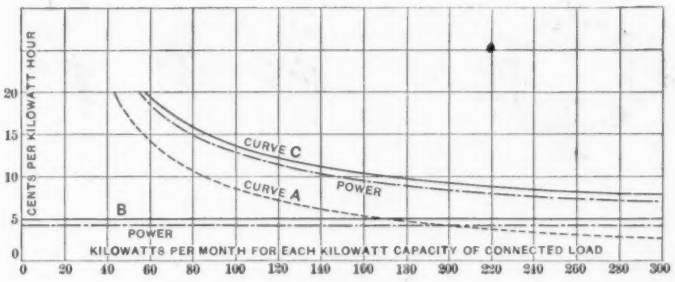


FIG. 1.

charges under the conditions existing in the station used for illustration.

The kilowatts on monthly meter readings are laid off horizontally and the cost in cents vertically, and a curve, *A*, is first plotted, the ordinate for any point of which is determined by dividing $8.66 (one-twelfth of the annual fixed charge) by the abscissa in kilowatts. A horizontal line, *B*, is then drawn through the point on the vertical scale expressing the average generating and distributing cost in cents per kilowatt hour (in this case 5 cents), and the sum of these two. Curve *C* gives the rate per kilowatt hour for any monthly meter reading. In order to ascertain the proper rate for a customer having more or less than one kilowatt capacity of connected load, the monthly meter reading should, of course, first be divided by the number of connected kilowatts.

It will be seen that this system for determining the minimum rate at which day customers (and long-hour night customers as well) can be profitably supplied, applies equally to those having very few lamps or very small motors as to those having large installations, and by extending its principles to such patrons, who now seldom get any appreciable discount, for the reason that their total monthly bills amount to but a comparatively small sum, a very large amount of business which to-day is compelled to use other illuminants, or other sources of power, might be taken on to the electric company's circuits with profitable results.

For power rates, the horizontal line representing the average cost per kilowatt hour at customers' meter, would be lower than the lighting line, by the amount of those accounts such as lamp renewals and maintenance of arc lamps, which do not enter into the cost of supplying motor service, and the rate curve, which is the sum of the fixed charge curve, and the kilowatt hour cost would naturally be affected in the same manner. In the accompanying curve the cost per kilowatt hour for power has been taken at 0.8 cents below that for lighting.

In offering this suggestion of a method for establishing rates it is not claimed that the plan applies to other cases than those of customers with comparatively high average consumption, nor is it proposed as a basis for a scale of prices, but merely as a simple means of determining proper discounts in particular cases, and the limit below which it is not profitable to sell current. The Wright demand system applies a somewhat similar principle, and by the means of a maximum recording meter at each service determines each customer's greatest draught on the station, charging him for his proportion of the fixed charges accordingly. If one were starting a new plant it might be desirable to institute this system, but without apparently changing one's rates, and without the additional apparatus, the plan herein outlined would enable a manager to ascertain whether his present day load were profitable, and to guard against making unprofitable contracts in the future.

Electric Lighting Subways.

METHODS OF THEIR CONSTRUCTION, ETC.

BY WILLIAM MAVER, JR.

So far as the matter of construction of electrical subways or conduits is concerned there is little, if any, difference between what are usually termed respectively the "high" and "low" tension systems, as distinguishing electric lighting and power subways

FIG. 1.—PIPES AT CORNER OF FOURTEENTH STREET AND BROADWAY NEW YORK.

from those of the telegraph and telephone. This statement is also true, it may be remarked, so far as concerns their method of operation, if we confine ourselves to the systems and methods which now most generally prevail in this country; that is, first, the "drawing in" systems, by which is meant those subways consisting of ducts and manholes underground, into which the wires, whether in the shape of cables or as bare conductors, are drawn into or out of the ducts at the pleasure of the owners, and, second, the "solid" conduit systems in which the conductors properly insulated are laid permanently in the earth, and of which the "Edison" conduit is the most notable example.

The opposition to placing electrical conductors underground in the large cities on the part of the "wire users," which was so strong ten or twelve years ago, has now almost entirely disappeared, and the remaining problem appears to be how to dispose the conduits underground to best subserve the interests of all concerned.

One simple plan would obviously be to grant each company permission to construct its own subway system, but this would quite as obviously be impracticable in all cases in view of the already crowded condition of many of the streets under the surface. An instance of the crowded condition of one of New York's streets underground is given in Fig. 1. This view was taken when the street was opened for the purpose of rearranging the gas, water and subway mains and pipes to make room for the construction of a cable road. While this picture may present a somewhat crowded condition of under-surface pipes, etc., it is not an unusual one, and hence it illustrates the difficulties that stand in the way of a general construction of subways for electrical conductors by the individual companies. This, therefore, brings up the joint occupancy of subways by the various companies—the plan already adopted in New York and some other cities—in which cities, however, the so-called "high" and "low" tension conductors are allotted separate conduits and manholes. To still further simplify the matter, so far as space underground is concerned, it is proposed in some cities to have a joint occupancy of the subways by all

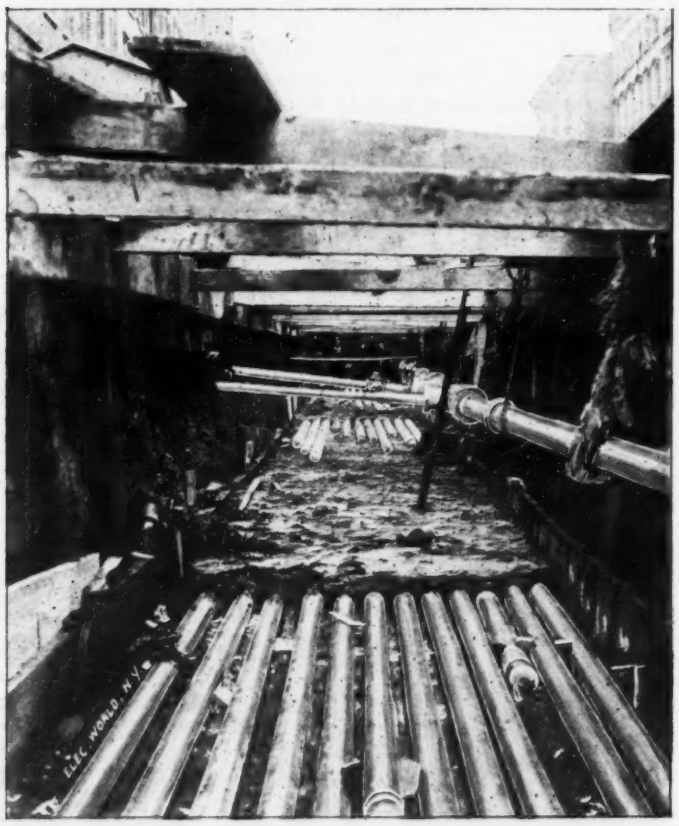


Fig 2.—Iron Pipe Conduit Construction.

classes of wire users. This it is proposed to do by assigning separate ducts in the conduits and compartments, or other means of separation, in the manholes for the respective conductors of the different electrical systems.

In the construction of electrical subways of the drawing in type, it is well known that the present practice is to use wrought-iron pipes, cement-lined pipes, wood pipes or some form of vitrified clay pipes or conduits, with the preference given at present perhaps to the cement-lined and clay or terra-cotta conduits, presumably on the score of economy, the costs of completed ten duct terra-cotta, cement-lined and wrought-iron conduits being in the ratio of 15, 22 and 33 respectively. The cost of the iron pipe being, of course, much greater than either the cement-lined or terra-cotta pipe, this ratio will diminish or increase with variations in the number of ducts employed in any given conduit. The cost of subway construction is also considerably affected by the type of pavement which has to be opened and replaced, and the expense of constructing a ten-duct subway under an asphalt pavement may exceed that under a Belgian block pavement by $3500 per mile. In fact it has been found advisable in one or two instances in this country to tunnel the street in preference to disturbing and replacing the asphalt pavement.

The Validity of the Berliner Patent.

BY GEORGE W. SUTTON.

Any additional information regarding the validity of the now famous Berliner patent of 1891 will be welcomed by thousands of people who are interested in the development of independent telephone companies. Since the expiration of the fundamental Bell patent on the receiving telephone these companies have sprung up in every State in the Union, and have grown rapidly until they are now in a position of power and prominence in many quarters. It is natural that their growth should cause the American Bell Telephone Company to view their progress with no great favor and use every means to retain the control of the immensely valuable business which they have built up under their former patents. The Berliner patent of 1891, after lying apparently dead in the Patent Office for fourteen years, was resuscitated in the year of its issue, and has now, after tedious and expensive litigation brought about by the Government, been sustained so far as the validity of its issue is concerned. The real question, however, which interests telephone companies on both sides of the struggle and which affects the vitality and value of the patent, is not the validity of its issue, but is its validity as a patent—is whether or not the patent is different from anterior patents granted to the same inventor, or whether it discloses any invention of novelty. It is the opinion of many lawyers learned in patent litigation that if the question of alleged infringement of this patent is ever brought into the courts it will be shown to be of no value. It is not necessary for the purposes of this article to dwell upon that phase of the case, however, nor to cite the various grounds which could be

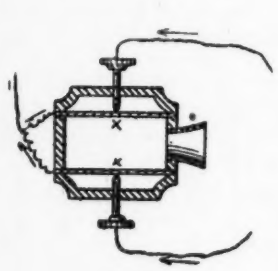


Fig. 1.

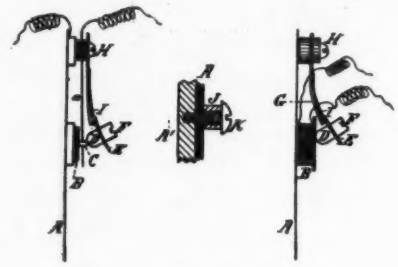


Fig. 4.

advanced in such a suit, for even admitting that the patent of 1891 is entirely valid and beyond dispute, and that it is legal to take out a patent for a chair, for example, and eleven years later repatent precisely the same thing under the same of a sofa, the Berliner patent has ceased to exist by limitation through the expiration of the English patent No. 91 on January 8, 1894.

The decision of the United States Supreme Court in the Bate refrigerating case, upholding the provisions of Section 4887 of the Revised Statutes, that "every patent granted for an invention which has been previously patented in a foreign country, shall be so limited as to expire at the same time with the foreign patent," applies to this as it did to the Edison patent of 1892. The fact that Berliner had taken out foreign patents has been stated before in the electrical journals, but it has so far not been put in such a light that every one can see at a glance the fallacy of further apprehension on this score.

The English patent reads, in part, as follows:

"Letters patent to William Robert Lake, of the firm of Hazeltine, Lake & Company, patent agents, Southampton Buildings, London, for an Invention of Improvements in Microphonic and Telephonic Apparatus. A communication from abroad by Emile Berliner, of Boston, Massachusetts, U. S. A., Electrician.

Claim No. 1. A microphone or contact telephone having no rubbing or frictional electric contact, and having the electrodes maintained in contact with one another, with a variable pressure by the pressure exerted by a body moving or sliding freely by the action of gravity at an angle inclined to such contact, substantially as above set forth and for the purpose specified.

No. 2. In a microphone or contact telephone having no frictional or rubbing electric contact, the combination with a vibrating surface forming one electrode of a pin forming the opposite electrode, and sliding freely on a suitable support inclined at an angle to the vibrating surface, and connected to the battery in such a manner that its free movement on the support will not be interfered

with, all substantially as above set forth and for the purpose specified.

No. 3. In combination with a vibrating surface forming one electrode, the block, *A*, provided with an opening or perforation inclined downward to the vibrating surface. A conducting pin or

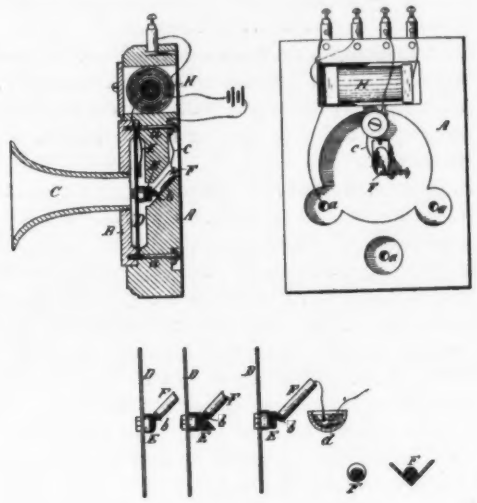


FIG. 3.

cylinder having a carbon extremity and sliding freely in the said inclined opening, so as to make contact at its extremity with the vibrating surface, and a connection between said pin or cylinder, all substantially as above set forth and for the purpose specified.

No. 5. A microphone, or contact telephone having only one contact affected by sound waves and consisting of two electrodes in contact with one another, which contact is varied during the transmission of sounds, by the variation in the pressure upon such contact of a pendulous weight, which is kept out of its point of rest by the interposition of said electrodes.

No. 6. In a microphone or contact telephone, the combination of a vibrating surface forming one electrode, a pendulous weight forming the opposite electrode, with or without a device for changing the inclination of the said weight.

No. 10. In combination with a diaphragm of carbon or other material forming one electrode, the self-adjusting opposite electrode capable of sliding into contact with the diaphragm, and of being firmly fixed in position after having adjusted itself in said contact substantially as above set forth and for the purpose specified.

No. 11. In a microphone or contact telephone having no rubbing or frictional electrical contact, the combination with a diaphragm forming one electrode of the opposite non-elastic electrode, capable of sliding freely towards the diaphragm until both electrodes come into contact with each other.

No. 12. The combination of two opposite electrodes, one of which has its weight so regulated as to exert pressure upon the

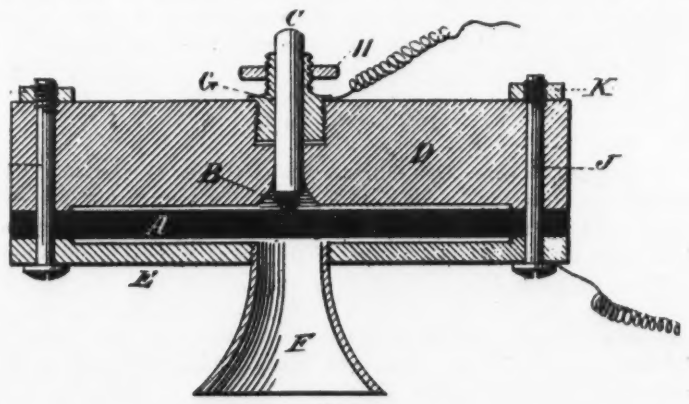


FIG. 2.

other, and slides toward the same, and is capable of being firmly fixed in position."

There are in all sixteen claims in this patent, but only the principal ones are here given. By reference to the principal claim of the '91 patent, "a method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in contact so as to strengthen and weaken the contact, and thereby increase and diminish the resistance of the circuit, substantially as described," and it will be seen that the English patent is for the same invention, and that therefore both patents expired January 8, 1894. Claims No. 1 and 5 and 11 are especially similar in that "the variable pressure of electrodes in contact with each other" is claimed in each. As the '91 patent covers all Berliner's various telephone patents in this country, so also are they all combined, drawings and all, in this English one. Figures 1, 2, 3 and 4 all appear and the specifications describe exactly how each one is operated and show conclusively that the constant-contact variable-pressure principle must be employed.

The figures herewith are those published in connection with the English patent as well as in the American patents. Fig. 2 relates to claim 10, Fig. 3 has reference to claims 1, 2 and 3, and Fig. 3 is referred to in claims 5 and 6. It seems that the standing of the Berliner patent in the face of the Bate decision, and of these English claims now expired, must be precisely the same as that of the subject matter of the case referred to. The patent is clearly invalidated by the expiration of the prior English patent, and a suit for alleged infringement of it will unquestionably produce a decision to this effect.

The Canadian Electrical Association Convention.

(Special telegraphic report from THE ELECTRICAL WORLD'S correspondent.)

One of the most successful meetings in the history of the Canadian Electrical Association was the convention held this week at Niagara Falls, Ont.

On Wednesday, June 2, the first session was opened in the convention hall of the Dufferin Cafe, in Queen Victoria Park. The meeting was called to order by President John Yule, of Guelph, Ont., who delivered a very interesting address, principally devoted to the subject of the municipal ownership of electric lighting plants. Mr. Yule, whose experience as manager of the electric lighting company in Guelph has given him great experience in such matters, has spent much time in studying the subject, and his presentation of his views was highly interesting. Mr. Yule's opinion is similar to that of the majority of electric light men, that municipal ownership is improper and leads in the end only to corruption and disappointment. After the reading of the minutes of the last meeting the report of the secretary-treasurer was received. This report showed that the financial status of the association was good and that its affairs generally were in a healthy condition. The first paper presented was by Mr. John Murphy, of Ottawa, on "Water-Driven Plants." This paper, which was a careful and accurate presentation of its subject, elicited some discussion, which was participated in by Messrs. Wright, Hunt and others.

Mr. A. M. Wickens, of Toronto, government inspector of boilers, read a paper on "The Steam End of an Electric Plant." This was followed by a general practical discussion, which lasted until the adjournment of the meeting.

In the evening at 7 o'clock, the members of the convention made a trip to Buffalo by special invitation of the management of the Buffalo & Niagara Falls Electric Railway Company. A visit of inspection was made to the Buffalo railway power house, the whole trip being made in special electric cars from Niagara Falls.

On Thursday, June 3, the convention assembled at 10 o'clock in the morning, President Yule being again in the chair.

A telegram was read from First Vice-President L. B. McFarlane, general superintendent of the Bell Telephone Company, Montreal, regretting his inability to be present at the convention, owing to the accident to Mr. Sise. The latter had the misfortune last week to fall and break his leg.

Mr. Kammerer's paper evoked a long and interesting practical discussion, which was participated in by Messrs. Wm. H. Browne, general manager Royal Electric Company; J. J. Wright, manager Toronto Electric Company; F. C. Armstrong, of the Canadian General Electric Company, and Messrs. Milne, Pepler and Wickens.

When the question of where the next annual meeting should occur came up, Mr. Browne, on behalf of the Royal Electric and the other electrical interests of Montreal and vicinity, extended a cordial invitation to the association to meet next year in the Canadian

metropolis. Mr. Browne pointed out that Montreal would next June have two water-power plants of the utmost interest to show the members of the association—the Lachine and the Chambly plants. The Lachine installation will include vertical turbines and the three-phase system of the Canadian General Electric Company, while the other will have horizontal turbines and the Stanley inducter system. He promised the association not only a Royal, but a Lachine welcome to Montreal.

After considerable discussion the association unanimously accepted Mr. Browne's invitation, and Montreal was selected as the place of the next meeting, one of the members facetiously remarking that Canadian engineers were familiar with the generation of electricity in English in the Eastern section of the Dominion, and that now they would have the opportunity of witnessing its generation in French at Montreal in the West.

Mr. Thompson's paper brought out quite a little discussion, which was joined in by Messrs. Milne, Wickens and Wright.

At 12 M. the meeting adjourned, and the delegates, in company with Manager Phillips, visited the power house of the Niagara Falls Park & River Railway.

The convention reconvened at 2 o'clock and elected the following officers for the ensuing year:

John Yule, Guelph, Ont., president; C. H. Mortimer, Toronto, Ont., secretary; Charles B. Hunt, London, second vice-president. Messrs. Wright, Smith, Carroll, Armstrong and Higman were re-elected members of the Executive Committee. Messrs. Brown and Thompson, of Montreal, De Young, Mortimer and Phillips, of Niagara Falls, and Bowman, of New Glasgow, were elected members of the committee.

Montreal was decided upon as the meeting place of the next convention. It was felt that if the Western members of the National Electric Light Association are willing to waive the selection of Chicago or some other Western city for the next meeting of that association, that it will be very appropriate and proper for the meetings of both associations to be held at Montreal next summer.

Among the papers read were: "Day Loads for Central Stations and How to Increase Them," by J. A. Kammerer, Toronto; "Submarine Cables," by D. H. Keely, Ottawa; "Determination of the Heating Power and Steam Value of Coal from a Preliminary Examination," by William Thompson, Montreal; "The Commercial Aspect of Electric Railways," by C. E. A. Carr, London; "Accumulators: Their Application to Central Station Lighting and Power," by W. A. Johnson, Toronto; "Why Some Lighting Plants Do Not Pay," by F. C. Armstrong, Toronto.

Friday was spent in a series of excursions to various points of interest, including the Niagara Falls Park & River Railway, the Gorge electric railway, the Hydraulic power house, the Incline railway, a trip to the foot of the falls on the steamer "Maid of the Mist," the power house and works of the Cataract Construction Company and visits to the factories of the Electro-Chemical Works.

The convention was by all odds the most enthusiastic and largest in the history of the association, and the interest in the papers and discussions seemed greater than ever before.

At 8 o'clock Thursday evening the annual banquet of the association was held in the Dufferin Cafe. About 100 were present, and those who had the good luck to attend pronounced the banquet a decided success.

Among those present were:

Messrs. John Yule, president, Guelph; C. H. Mortimer, secretary, Toronto; Chas. B. Hunt, second vice-president, London; J. J. Wright, Toronto; A. B. Smith, Toronto; A. M. Wickens, Toronto; F. F. Dryden, Toronto; J. W. Campbell, Toronto; W. Bourne, Toronto; Albert Esling, Toronto; F. H. Leonard, Jr., Toronto; Frederic Nicholls, Toronto; W. A. Johnson, Toronto; George Black, Toronto; J. A. Kammerer, Toronto; Joseph Wright, Toronto; A. A. Christie, Toronto; Irving H. Smith, Toronto; E. K. M. Wedd, Toronto; Geo. A. Wilkie, Toronto; John C. Gardner, Toronto; E. B. Biggar, Toronto; John Carroll, Montreal; Wm. H. Browne, Montreal; Wm. Thompson, Montreal; Stephen Noxon, Ingersoll; George Shand, Sarnia; Wm. Williams, Sarnia; G. A. Powell, St. Catharine; W. Bourne, St. Catharine; John Murphy, Ottawa; B. F. Reesor, Lindsay; H. O. Fisk, Peterboro; W. F. McLaren, Hamilton; W. H. Comstock, Brockville; W. H. Bullard, Seaforth; James Lamont, Chatham, Ont.; C. E. A. Carr, London, Ont.; J. M. Brown, Carlton Place; F. Pepler, Barrie, Ont.; E. F. Freeman, Halifax, N. S.; F .A. Bowman, New Glasgow, N. S.; V. B. Coleman, Port Hope, Ont.; John Farley, St. Thomas, Ont.; J. W. Purcell, Walkerville, Ont.; Geo. Phemistee, Niagara Falls, Ont.; C. H. Philbrook, Buffalo, N. Y.; H. E. Adams, Buffalo, N. Y.; Thos. Duncan, Fort Wayne, Ind.; W. J. Johnston, New York, N. Y.

CONVENTION NOTES.

Mr. F. H. Leonard, Jr., representing the Packard Electric Company, was one of the most active men at the convention. He distributed a neat little vest-pocket book for daily notes, and incidentally dwelt upon the merits of Packard lamps, transformers, and other specialties.

Mr. H. E. Adams, Buffalo, representative of the Central Electric Company, Chicago, was in evidence throughout the convention. Mr. Adams does a large business throughout Canada for the Central Electric Company, and missed no opportunity to mention the good qualities of the specialties handled by his company.

Mr. John Carroll, secretary and treasurer of the Eugene F. Phillips Electrical Works, Montreal, wore the red ribbon of the Executive Committee. For seven years Mr. Carroll has had charge of the Eugene Phillips Electrical Works. The business of the company continues to grow each year, and Mr. Carroll is so pleased with Canada and the Canadians that he will probably spend the rest of his life in the Dominion.

Mr. Burt Van Horne, general manager of the Buffalo and Niagara Falls Electric Railway, earned the cordial thanks of the members of the Canadian Electrical Association, not only by placing special cars at their disposal for a trip from Niagara Falls to Buffalo, on Tuesday evening, June 2, but in personally meeting and welcoming his guests and escorting them through the interesting and admirably-arranged power house of his company.

The Fort Wayne Electric Corporation, Fort Wayne, Ind., was represented at the convention by the inventor of the well-known Duncan alternating-current meter manufactured by that company, Manager Philbrook, of the Rochester agency, was also in attendance and distributed some interesting literature regarding the Duncan meters and the Wood system of electrical machinery manufactured by the Fort Wayne Electric Corporation.

Mr. W. H. Browne, well known for his connection with the early days of electric lighting in New York, and now general manager of the Royal Electric Company, Montreal, was one of the prominent figures at the meeting. The Royal Electric Company is doing important work, both in the practical development of electric lighting and also in the manufacture and introduction in Canada of the Stanley induction system. Mr. J. A. Kammerer, who read an interesting paper at the convention, is manager of the Toronto branch of the Royal Electric Company.

Mr. Frederic Nicholls, president of the National Electric Light Association, was a welcome visitor at the second day's session of the convention. Mr. Nicholls has worked hard to insure the success of the coming National Electric Light Association convention. He has also devoted much intelligent attention during the year to the permanent strengthening of the association. Mr. Nicholls believes that the association should be even more of a power in the electrical field than it has heretofore been. His own efforts have certainly done much to this end.

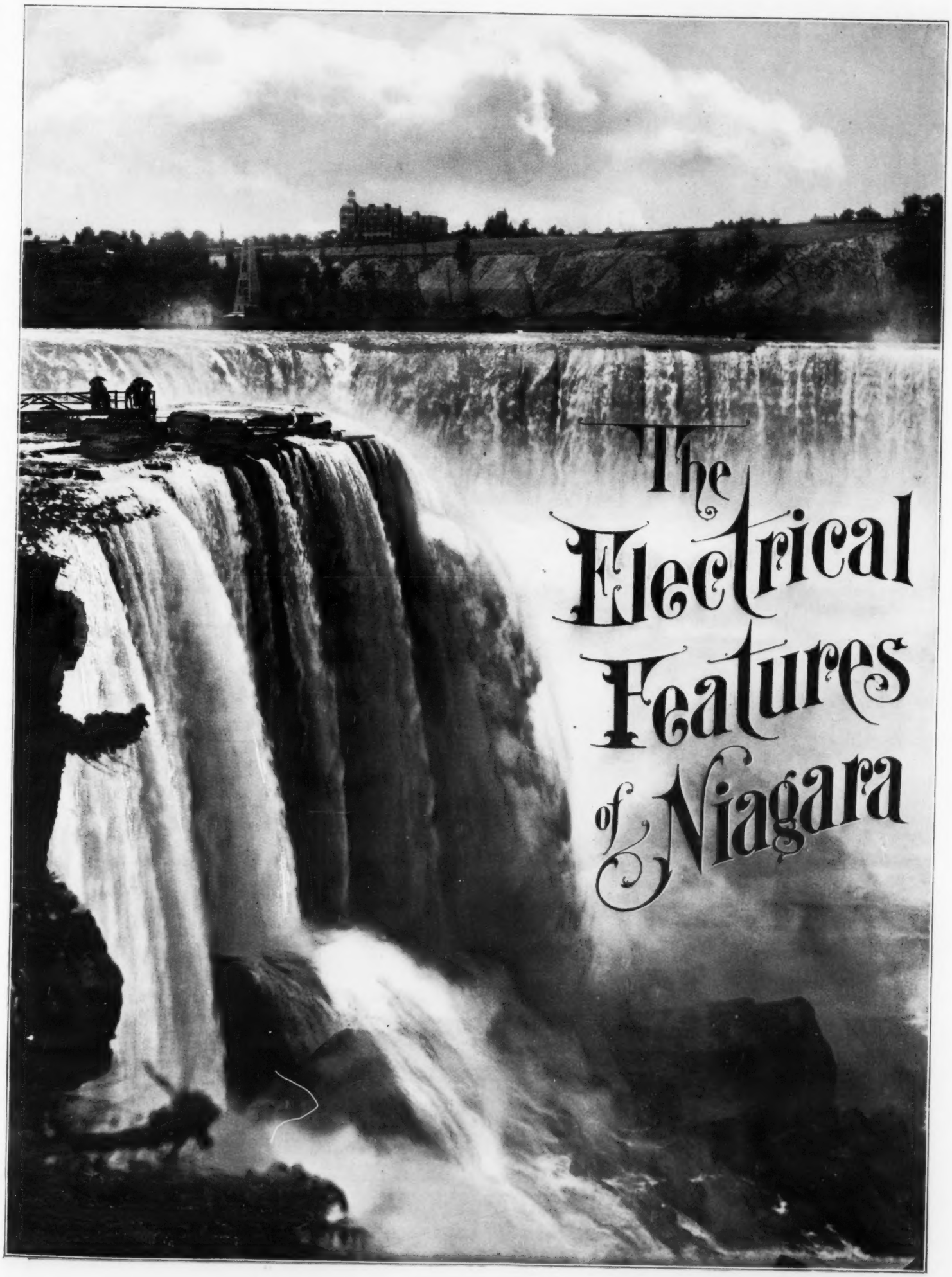
The Pacific Cable.

Private letters from Honolulu say that the Dole Government has decided to give to the British company the concession for the ocean cable. The Hawaiian Government has grown weary of the lukewarm attitude of the United States over the cable question, and has closed with the British proposals.

Recently the British war vessel Pelican left Sydney to make a survey to Fanning Island, and the Wildswan recently left Honolulu to survey cable routes around that island, which will be the main landing place for the cable.

Dead Man's Curve in Paris.

The tramway crossing the Champs Elysees scored its first victim last week, when a policeman was knocked down and severely injured in trying to prevent a collision between a carriage and an approaching trolley car.


The Electrical Features of Niagara

Facts and Figures About Niagara.

The Falls were first described by Jacques Cartier. Probably the first white man who ever saw them was Father Hennepin, the missionary and explorer, who visited the cataract in the year 1678.

The American Fall is 167 feet high, and has a contour of 1,060 feet. Its recession is almost unnoticeable. The Canadian or Horseshoe Fall is 158 feet high, with a contour line of 3,010 feet. Its recession has been about 30 inches annually since 1842, although this is nearly doubled at the centre of the channel, where the flow of water is greatest. The Falls receded at the acute angle of the horseshoe more than 200 feet in eleven years.

About 107,000,000 gallons of water per minute is the normal rate of flow at Niagara. This corresponds to about 2,500,000 horse power.

The depth of the water going over the Falls varies about six or seven feet, the variations being generally caused by winds which affect the levels of the lakes.

The full amount of water to be withdrawn by the tunnel will lower the level of the Falls about two inches.

The electrical developments of power in operation, or in process of installation at present represent a total of 52,000 horse-power.

The present distribution of power among the various industries at Niagara is as follows :

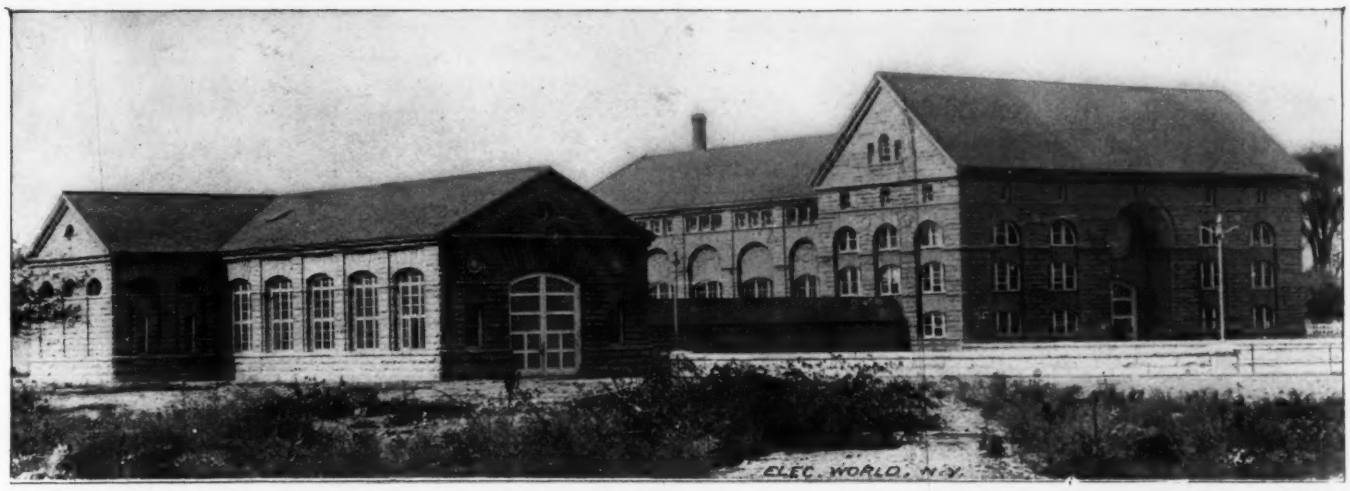
In the electro-chemical industries, a total of 11,000 horse-power.

For railway purposes, a total of about 1,000 horse-power at Niagara Falls, and about 1,000 horse-power in Buffalo.

For electric lighting at Niagara, about 600 horse-power.

For small power uses at Niagara Falls, about 400 horse-power.

The Buffalo transmission line is 27 miles long, and now conveys about 1,000 horse-power as tri-phase current, at a pressure of 11,000 volts. Its ultimate capacity is about 5,000 horse-power at 22,000 volts, to which pressure the current is soon to be raised.



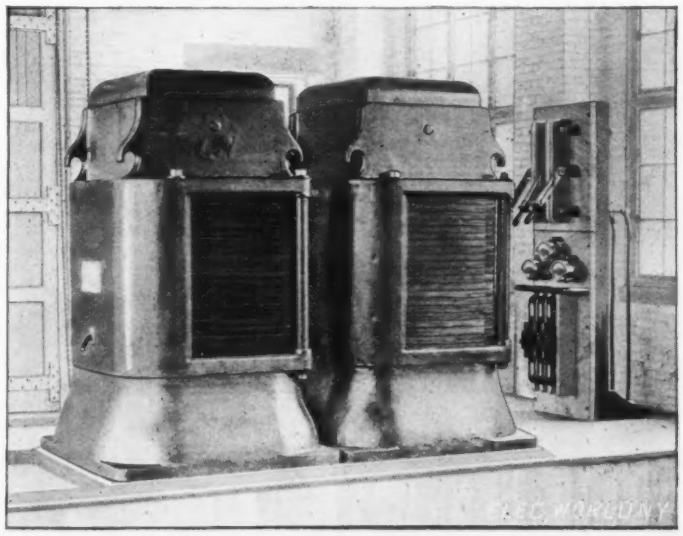
EXTERIOR OF THE NIAGARA FALLS POWER COMPANY'S POWER HOUSE.

The Niagara Falls Power Company.

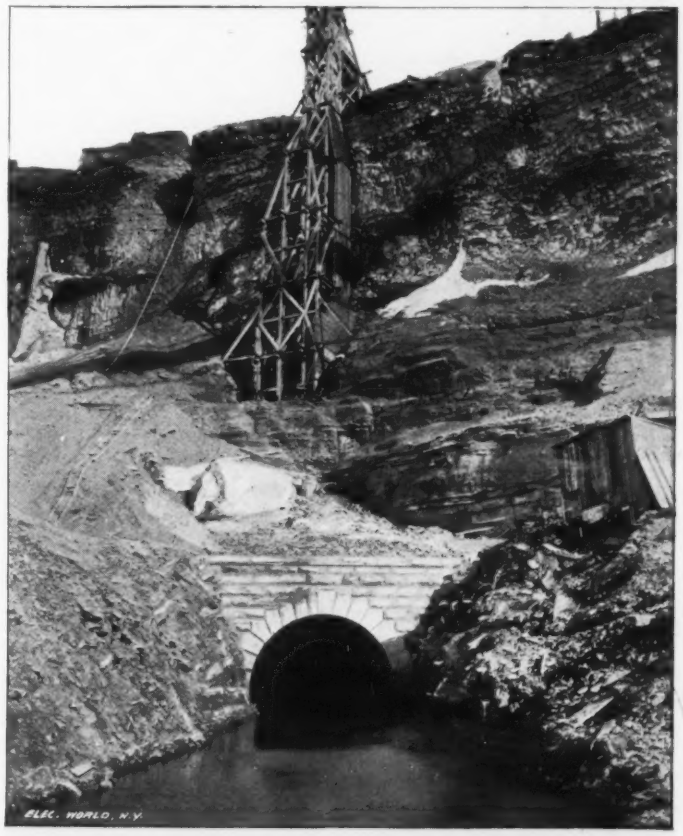
PERHAPS no plant has ever been so much and so fully described as that of the Niagara Falls Power Company. The colossal hydraulic developments which were undertaken to supply power for the generation of electric current on a scale hitherto unknown, the enormous machinery which was installed, the serious attempt to transmit a very great power to a considerable distance, and the discussion by electricians the world over of the problems involved in its construction, have all contributed to make it the most interesting development of the electric arts. It has been so frequently described in all its parts that anything more than a brief summary would seem to be out of place at this time.

The original idea which has been carried into such elaborate execution was first suggested by Thomas Evershed over fifty years ago. His plan was to construct a canal leading from the still water of the Niagara River at a point sufficiently far above the falls to permit the establishment there of docks for shipping, and to drive a tunnel from the lower end of the river, below the falls to a point under this canal, thus securing a very high head of water without in any way detracting from the beauty of the scenery. This plan has been carried out, perhaps more fully than Evershed contemplated, and now 15,000 horse-power of the contemplated 50,000 is actually being developed, while the machinery for 25,000 horse-power additional is being rapidly installed. The canal which brings water from the upper level of the river to the power house is about 180 feet long and twelve feet deep, having a cross section sufficient to deliver water for the generation of 100,000 horse-power. It will not, however, be a difficult matter to enlarge this canal, should that prove desirable, to two or three times its present capacity.

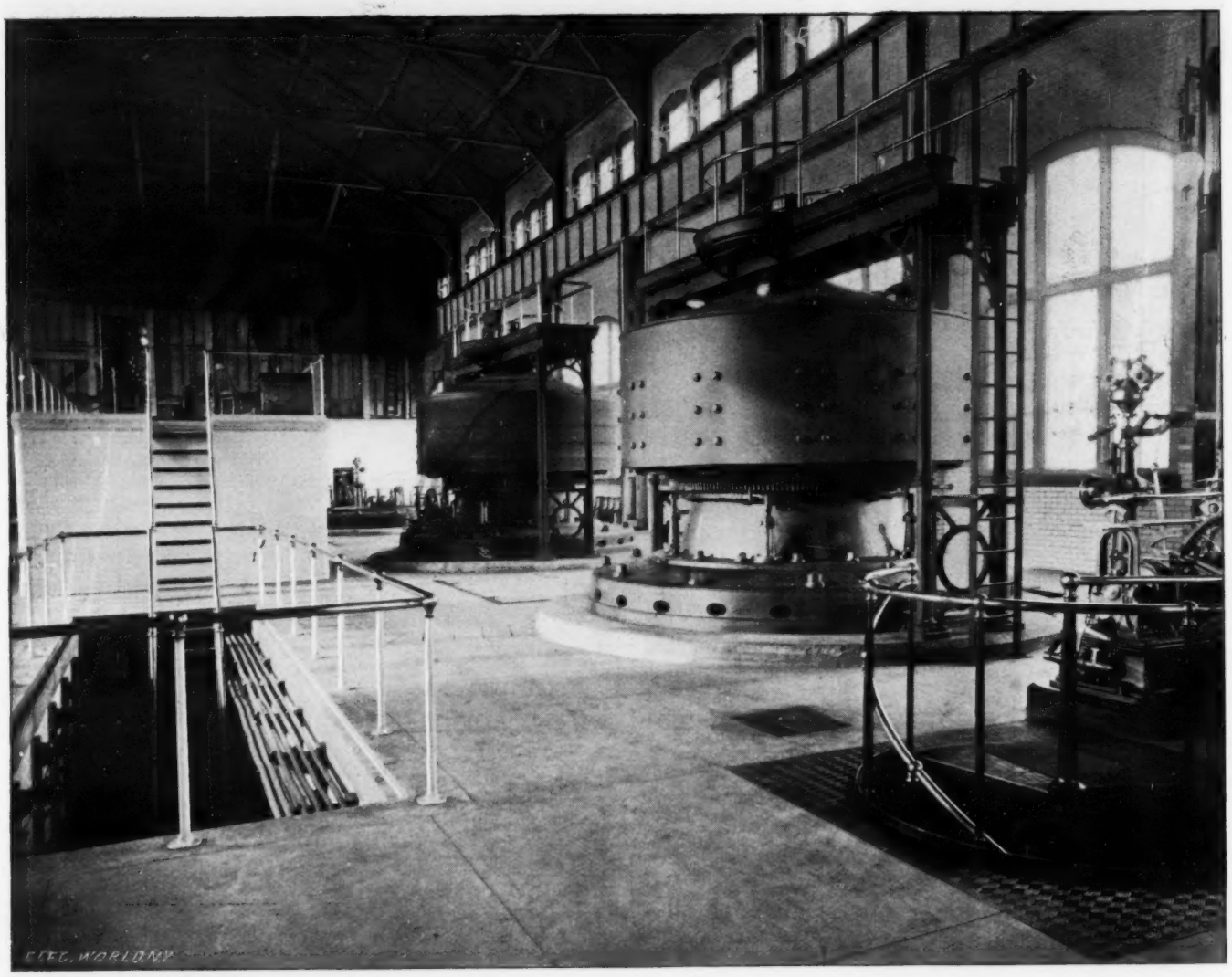
The wheel pit in which the great turbines run is an excavation 180 feet deep, 30 feet wide and about 200 feet long, every inch of which is excavated in the solid limestone rock. Into this pit, the penstocks, ten in number, which are constructed of steel and are nearly eight feet in diameter, bring the water down to the turbines under a head of 180 feet. These turbines present several peculiar and novel features. They were designed by a firm of Swiss engineers, who had had considerable experience in similar installations in their own country, and constructed by the I. P. Morris Company, Philadelphia. Each turbine is capable of delivering 5500 horse-power when operating at its normal speed of 250 revolutions per minute. The enormous weight of the turbines and their vertical shafts necessitated the balancing of the wheels, which was ac-



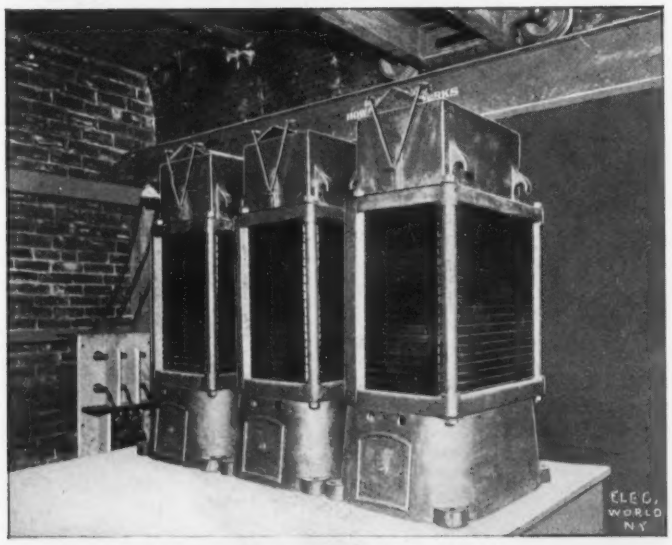
STATIC TRANSFORMERS AT NIAGARA END OF BUFFALO TRANSMISSION LINE. 2200 VOLTS 2 PHASE TO 11,000 VOLTS 3 PHASE.



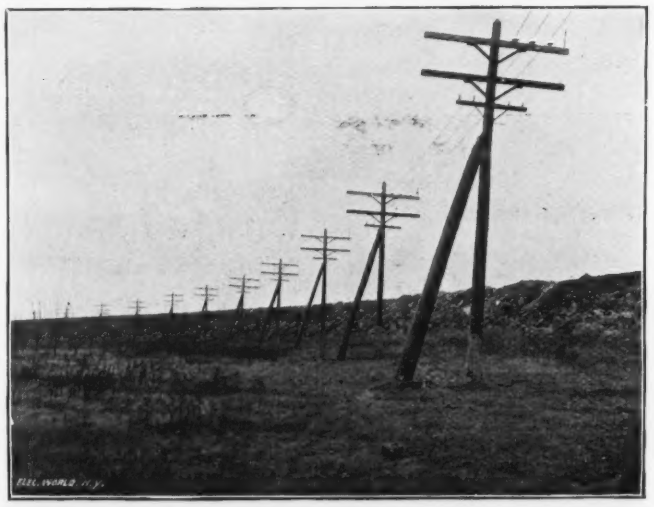
THE PORTAL OF THE GREAT HYDRAULIC TUNNEL.



Two of the 5000-hp Dynamos, Niagara Falls Power Company's Station.



Static Transformers at Buffalo End of Transmission Line.



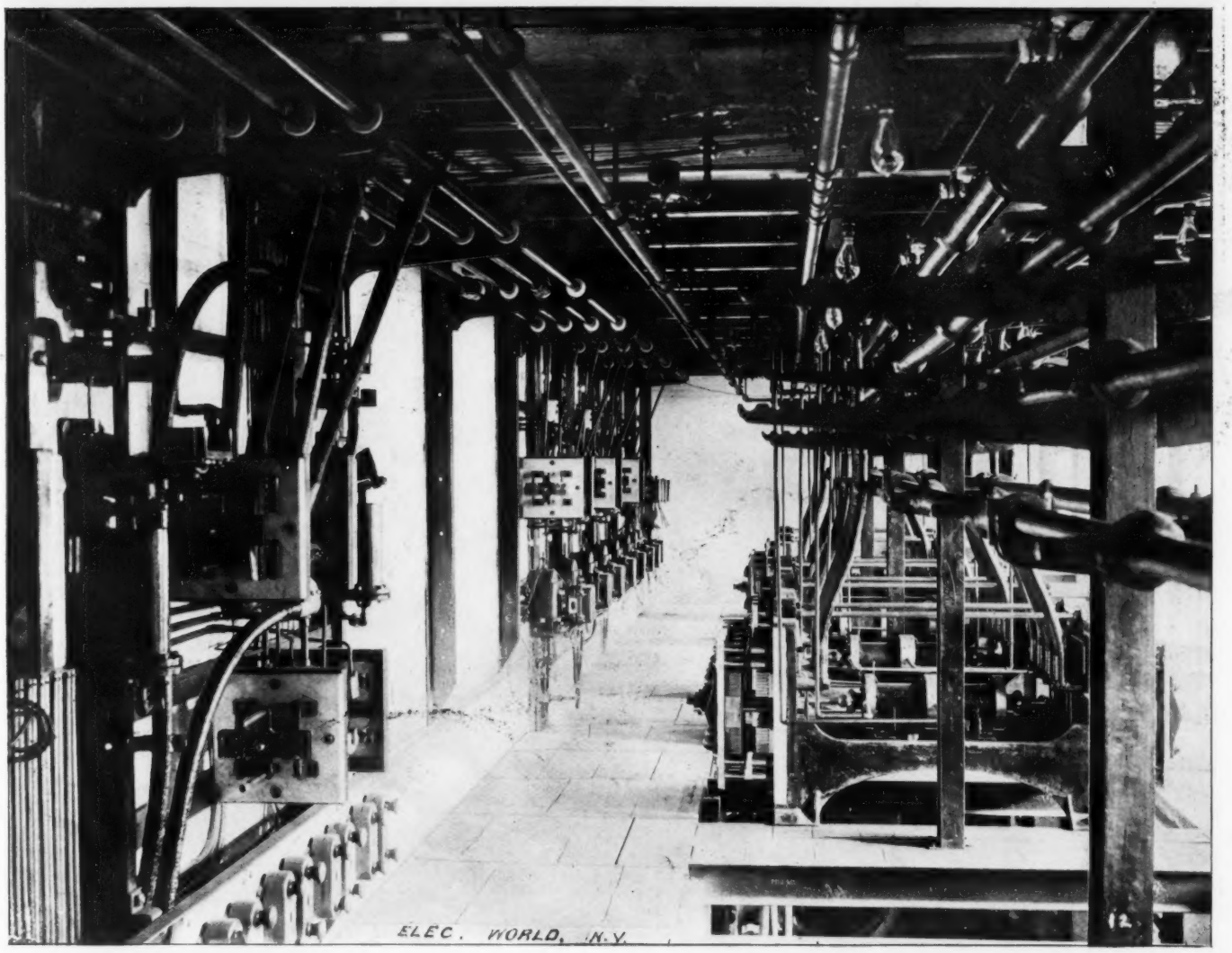
A Curve on the 11,000-Volt Niagara–Buffalo Transmission Line.

complished by admitting the water at the lower side of the cases, thus providing an effectual counterbalance.

The main shaft consists of a steel tube thirty-eight inches in diameter with walls three-fourths inch thick. At the bearing the shaft becomes solid and is reduced to eleven inches in diameter.

The great dynamos are mounted directly on the upper ends of the vertical shafts and are revolved in a horizontal plane. The armature is cylindrical and stationary and has a two-phase winding, giving at the normal speed 2200 volts and 850 amperes in each phase. The field magnet is a steel ring revolving outside of the armature and carrying twelve pole-pieces, which project inwardly. The exciting current is fed through two rings at the top of the machine. The governing of each turbine is accomplished by means of a centrifugal governor designed by Messrs. Faesch & Piccard, the designers of the turbines. These governors are not different from others of the mechanical class, and while operating very successfully merit no detailed description.

The controlling arrangements for the handling of the enormous current given out by these great generators are operated entirely by compressed air. There are two sets of bus bars so arranged



TWO-PHASE SWITCHBOARD OPERATED BY COMPRESSED AIR, NIAGARA FALLS POWER COMPANY'S STATION.

that any combination of machines and circuits can be made to either. There is a resistance provided to short circuit the discharge current of the fields when they are cut out. On the switchboard a panel is provided for each dynamo, containing an ammeter, wattmeter and voltmeter for each phase, a direct current ammeter in the exciter circuit and a synchronoscope. The arrangement of the dynamos and the switchboard in the building can be best seen from the illustrations herewith.

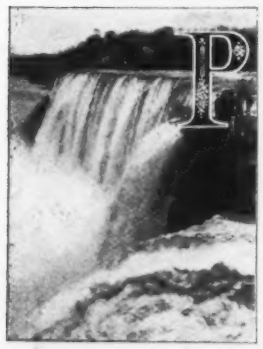
The currents generated by the large dynamos are at 2200 volts, two-phase. For the railways in Niagara Falls these are transformed by a static transformer in each phase to about 400 volts and led to a rotary converter. For the Buffalo transmission they are stepped up to 11,000 volts, three-phase, by two gigantic static transformers. These are so arranged that a change of connections will give 22,000 volts, should it be decided to use this pressure on the line. The insulators and cables can easily stand it.

The power station is a work of pleasing simplicity of architecture, though with some pretensions to decorative design. It is constructed of the limestone quarried from the wheel-pit and stands at the back of a well-kept lawn. The end of the building toward the extension of the wheel-pit is temporarily closed with a board partition, so that the building may be indefinitely extended as the requirements demand additional wheel-pit excavations and extension of the generating plant. Near the building, but on the opposite side of the canal, is a small building of the same general style, containing the transformers, the two being connected by a conduit or hallway for the mains. A visitors' gallery is provided in the main dynamo house, and this has proved a very attractive point for many tourists at Niagara Falls. In the offices on the ground flour of the dynamo house are a very elaborate set of registering and recording instruments, which are kept constantly in circuit, and show at a glance the condition of the lines and dynamos. The visitor to the plant is struck at once with the extreme neatness of his surroundings and by the cyclonic wind which is stirred up by the revolution of the enormous dynamo fields. From the transformer house radiate the various lines to Buffalo and elsewhere, which carry away the power generated in the main plant. The transformers, two in number, for the Buffalo transmission line receive the two-phase current at 2200 volts and send it out as three-phase current at 11,000 volts. The switchboard and lightning arresters for this line are beautiful examples of careful workmanship.

VIEW ON THE NIAGARA FALLS AND BUFFALO RAILWAY.

Three 5000-hp, 2200 Volt, Two-Phase Dynamos in Niagara Falls Power Company's Station.

The Niagara Falls-Buffalo Power Transmission Line.

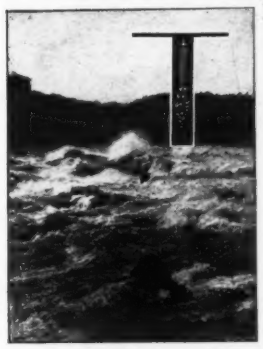


POWER transmission between Niagara Falls and Buffalo is accomplished over a line, partly aerial and partly underground, about twenty-six miles long. The cables, three in number, which carry the three-phase current at 11,000 volts from the transformer house at the falls to the city line of Buffalo, are of stranded copper, of 350,000 circular mils cross section. These cables are bare, and are supported on triple petticoat porcelain insulators of a peculiar design, each of which was tested at a pressure of 40,000 volts before being placed in postion upon the poles. At the city line of Buffalo the three aerial cables are connected to three cables of 350,000 circular mils, each rubber-insulated and lead-sheathed, which are laid in a conduit running along the canal to the transformer house of the Buffalo Street Railway Company. These cables were tested before laying under 80,000 volts pressure, and have given very satisfactory service since their installation. At 11,000 volts their capacity is about 5000 horse-power. It is anticipated, however, that before long the pressure on the transmission line will be doubled, and its capacity at 22,000 volts will, of course, be proportionately large. The conduit contains six ducts capable of eventually holding cables sufficient for the delivery of a total of 20,000 horse-power to the Buffalo Street Railway Company. At the transformer house, three of the tension mains enter through the underground conduit and are carried overhead on the walls of the transformer house to three Wood lightning arresters. The static transformers reduce the potential of the current to 500 volts, at which pressure it is led, through six rubber-covered cables of 600,600 circular mils each, to the two rotary converters. These have a capacity of 400-kw each and operate at 500 revolutions per minute. They are of the six-pole type, and transform the three-phase alternating current of 500 volts to a direct current of the same pressure. The rotaries are started by means of the direct 500-volt current, and when up to speed the three-phase current is switched on. From the rotaries run a set of 750,000 circular mil cables to the distributing switchboard, which permits the current to be switched to any of the feeder circuits in the city or to be put in multiple with any of the generators in the power house. In the main power house at Niagara Falls are three railway rotary converters, each having a capacity of 650 horse-power. These receive the two-phase current at 2200 volts from the large generators and deliver current at 575 volts to the Buffalo & Niagara Falls Street Railway Company, the Whirlpool Rapids line, and the Main Street line in Niagara Falls. Two of these machines were furnished by the Westinghouse Company, and one by the General Electric Company, and each has its own controlling switchboard. The static transformers at both ends of the long transmission line are cooled by means of fans driven by small motors. Each of them has a capacity of 1250 horse-power, and an efficiency at full load of nearly 98 per cent. The efficiency of the whole transmission line is stated to be well above 80 per cent. at full load.

A great part of the success of the line is due to the splendid performance of the insulators, which were manufactured by the Imperial Porcelain Works, Trenton, N. J. They are about five inches in diameter, and are provided with a lip at the base of the upper convex part, which conducts rain water to two small spouts situated at opposite ends of the diameter, thus preventing the dripping of water from the edge of the insulator to the cross arm. Their high resistance qualities are due to the fact that the porcelain, instead of being glazed as in ordinary insulators, is practically fused throughout the mass. The aerial construction is of the most careful description, rendered especially so by the fact that the line crosses other lines in several places. No insulation other than that due to the porcelain insulators is attempted on the aerial lines.

The Niagara Falls & Lewiston Railway.

BY J. R. HASKIN.



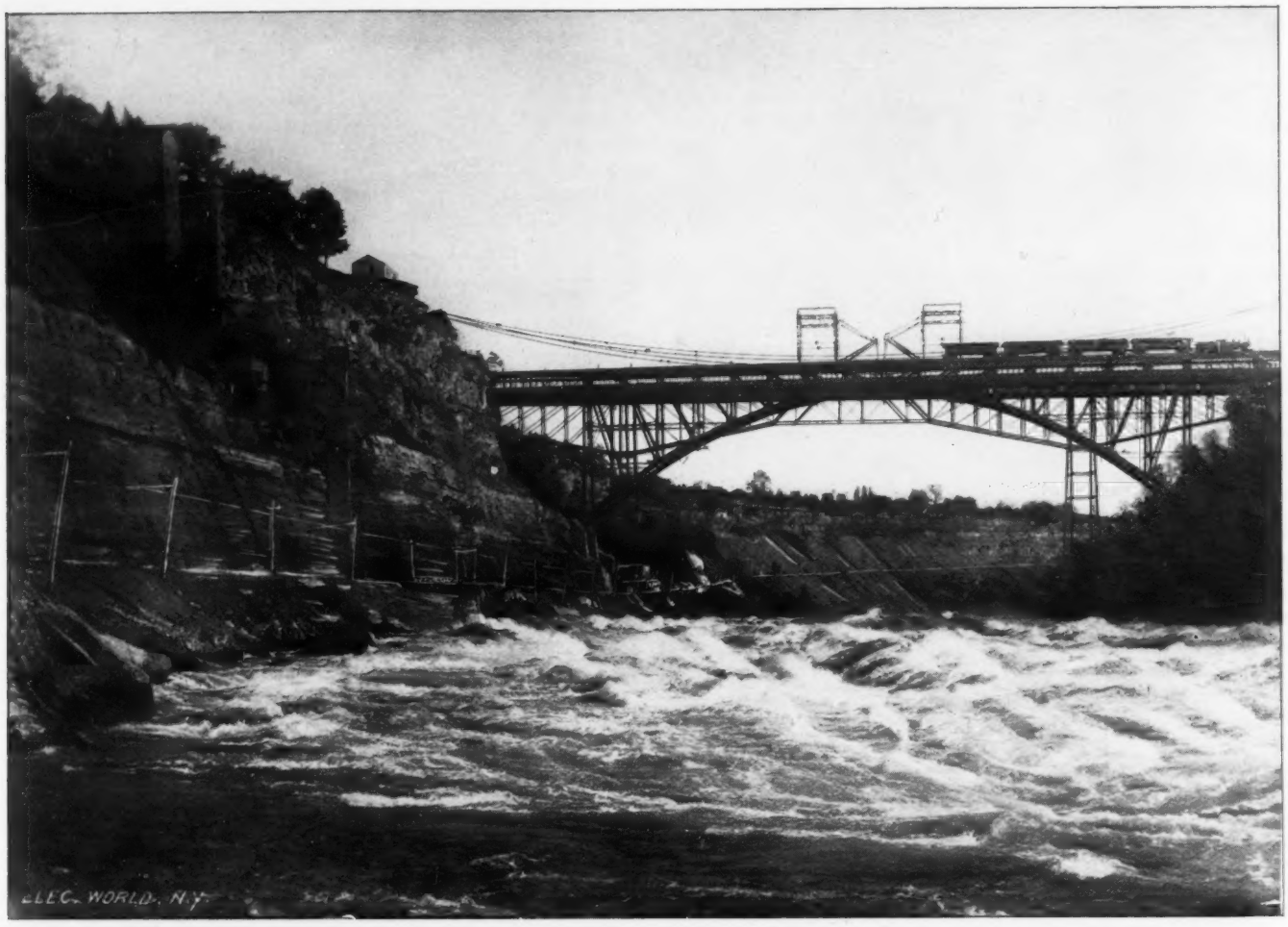
HREADING down the side and along the base of the great cliffs which form one of the banks of the mighty Niagara, so close to the rapids in some parts that their spray is often blown into the faces of the passengers, the Niagara Falls & Lewiston Railway Company's track winds its way from Niagara to the level country below Lewiston Mountain. The grandeur and magnificence of the scenery is impressive when viewed from the edge of the bluffs overlooking the river, but no one can form a correct idea of the tremendous force with which the river rushes through the gorge, until he has been by the water's edge and seen the enormous waves dashing and rolling hither and thither, past the suspension bridges, through the whirlpool rapids, and then making a sharp turn to the right, plunging onward until it reaches the villages of Lewiston and Queenston, where it finally sweeps out into a broad and comparatively calm stretch. The falls of Niagara, together with the rapids below, have often been termed the eighth wonder of the world, and certainly there is nothing to compare with them in this country until we reach the far West, where the Yellowstone Park and Yosemite Valley present other and different scenes of wild magnificence.

A PART OF THE LONG GRADE.

Nearly ten years ago Captain John M. Brinker realized that something ought to be done to accommodate the thousands of visitors who were unable to appreciate the full beauty of the gorge scenery, owing to its inaccessibility, and decided that a railroad of some description running from Niagara Falls to Lewiston, along the edge of the rapids, was the only solution. When he broached the project to a number of his friends, he was laughed at, and told that it was an impossibility, but, with his usual determination, he took up the subject earnestly, and after several years spent in securing a right of way and making plans and estimates, in 1890 parties were sent out to survey the route for the prospective railroad. In many places the only way of getting down into the gorge was by means of ropes, the engineers being lowered from the cliffs by their men above, and many narrow escapes have been recorded.

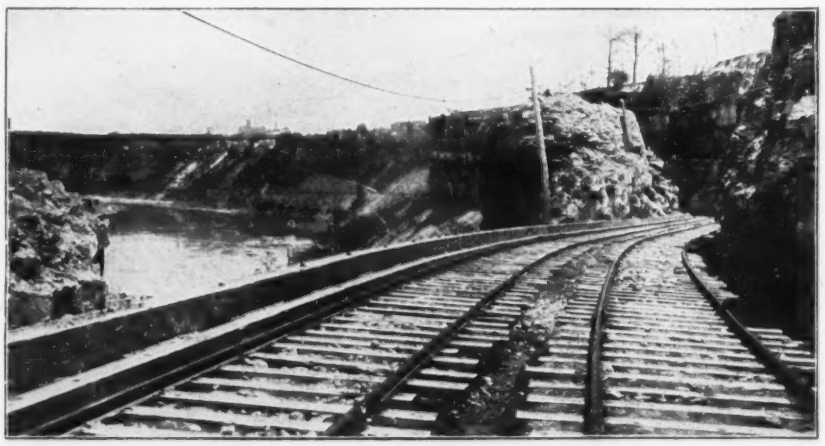
However, the surveys were finally made, and in the spring of 1895 more than a thousand men were put to work blasting and grading the line laid out from the Buttery Whirlpool to Lewiston, a distance of about five miles. The difficulties to be overcome were enormous. In no part of the route was there room enough for the proposed line, it being necessary to blast or dig every foot of the way through the broken bowlders, earth, and fallen trees which form the talus of the cliffs. Many thousand cubic feet had to be blasted out of the cliffs themselves, and the broken stone removed and built out to form a roadbed. In many places a much wider space was dug away to make provision for land slides, and, in others, immense boulders were used to make new ground, jutting into the river bed. The winding course of the roadbed has often been criticised by engineers, they claiming that many of the curves were unnecessary, but the builders of the road evidently intended that it should be so, as the curves themselves permit of so many more glimpses and views of the scenery by the tourist. On each side may be seen the rapids lashing against the huge submerged rocks, while overlooking and, in many places, overhanging the road, are the frowning walls of solid rock ranging from 200 to 300 feet in height. It would be impossible to see these if the track were straight, but the various windings in the roadway permit of the finest and most satisfying views.

In spite of all these obstacles, this section of the roadbed was finished, including a bridge 120 feet in length at the lower entrance of the gorge near Lewiston. At intervals across a steep narrow gulley cut in the river bank here, eight heavy 10 x 10 hemlock timbers, varying from 15 to 45 feet in length, were set, on which the bridge proper of hemlock stringers was built. The track was laid, the poles set and overhead line erected, and in eighty-seven days from the commencement of the work the first trolley car was put in operation over the line. During the Summer of 1896 passengers were transferred at the Buttery Whirlpool elevator from the surface cars to the gorge line, and in that way a complete trip was made from the Tower Hotel in Niagara Falls to Lewis-



Along the Whirlpool Rapids. Grade in the Distance.

ton. Meanwhile the rest of the road was being pushed forward. The mile of road between the Buttery elevator and Third street, Niagara Falls, is probably the most expensive piece of construction for its length that can be found on any railroad in the United States. Its exact cost is not obtainable, but an idea of this can be had from the fact that the dynamite alone used in the blasting cost $16,000, besides which great quantities of gunpowder were used. Shortly after leaving the line of Third Street, the road descends into the solid limestone, through which the gorge has been cut by the action of the falls in prehistoric times, and drops with a grade of 5 per cent. for a distance of 1000 feet through a cut which carries it under the New York Central tracks. On reaching the edge of the bluff, the road turns to the right and then, for nearly a mile, it is blasted from the solid rock side of the Niagara canon. In some places it was necessary to blast from the top of the canon down a depth varying from 100 to 200 feet, in order to obtain sufficient room for the two tracks of the railroad. The 5 per cent. grade along this stretch carries the road to the lower bank of the river, within a short distance of the abutments of the cantilever bridge. Here another difficulty blocked the way. On reaching the piers of the cantilever bridge it was found impossible to go between them and the shore, owing to the obstruction caused by the foundations of the new steel arch bridge, which was being constructed a few hundred feet to the north of the cantilever bridge. The bridge company would not allow any blasting within 100 feet of their piers for fear of weakening them, and the only way to get past was by building around the piers on the river side. The piers are situated almost at the water's edge, on rocks that descend into the river bed at an angle but a few degrees from the vertical, and it was necessary to sink heavy masonry piers for a bridge 160 feet long. This was accomplished with great difficulty, owing to the depth of the river at this point, and the enormous rapidity of the current. The pier at the south end was protected by a sea wall, which, in turn, was made secure by riprapping with hydraulic cement. On these piers plate girder spans were placed, and the track was thus carried around the obstruction. From this point on to the Buttery elevator, it was necessary to again excavate from solid rock, many thousand tons being removed. It was here that the blasting operations of the contractors were a cause of international complication, owing to the fact that fragments of rock were thrown upon the Caradian shore, many feet from the edge of the bank, causing

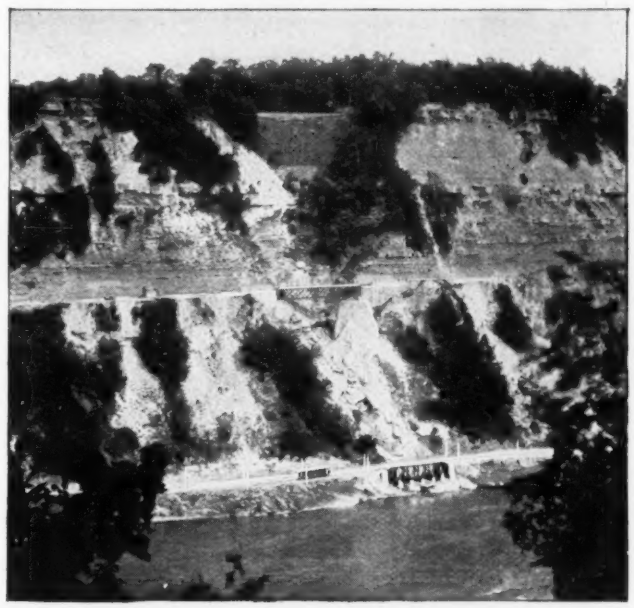


Safety Guard Rails Near Top of Grade.

some damages to property, and, it was claimed, endangering the lives of the citizens of Her Majesty's dominion. The Mayor of Clifton, the town situated on the opposite bank, protested to the Canadian authorities at Ottawa, who, in turn, wrote to the Secretary of State at Washington, who left the matter to Governor Morton, who instructed his deputy attorney-general to investigate. He, as one newspaper at the time put it, "set inquiries on foot, but, owing to the difficulty of traveling on foot from Albany to Niagara Falls, the railroad was completed before they arrived."

All in all, the permanent way, completed for a distance of seven miles, is estimated to have cost a little over one-half million dollars. Difficulties apparently insurmountable were overcome, of which only a part have been mentioned. Nothing but a trip over the road can make one realize just how difficult the work was. Before the road was built, probably not half a dozen explorers had ever traveled over some parts of the road, and yet in these places it was necessary for gangs of men to work with drilling machines and wheelbarrows, and wield pickaxes and spades, oftentimes hanging with one hand to the branches of the trees, while with the other hand and feet they would push and pry huge boulders from their places and tumble them into the river below. In other places the banks were treacherous and gave way under the workmen's feet, frequently tripping them up and rolling them to the very edge of the swift flowing water. Perseverance and indefatigable industry can overcome anything, however, and the work of cutting out the roadbed was finally completed.

The gorge route is laid with double track its entire length, of 60-pound Bessemer steel T rails. There are four cross-over switches placed at convenient intervals, and everything has been done in the most approved fashion. The safety devices are one of the great features of the line. The roadbed is either of solid rock or of broken rock taken from the cliffs, and is, of course, very stable. Running along the outer edge is a 6 x 6 oak guard rail, the sections being securely jointed together and fastened to the ties every few feet. In some places extra precautions have been taken. On the grade from the New York Central bridge to the lower suspension bridge, heavy oak 12 x 12 timbers are laid outside of the regular guard rail, and securely bolted to each other and to the ties. The inner edge of the guard rail is also reinforced by strips of angle iron. At the foot of the declivity it is intended to place a safety device which will prevent any possible runaways from reaching the curves near the cantilever bridge, by switching them on to a side track having a decided up grade, and thus speedily bringing them to a stop. Further along, where the roadbed was dug from the drift rock, it has been widened so as to allow a space of about four feet between the track and the outer bank. On the edge of the slope round logs of twelve to fourteen inches in diameter were securely bolted, thus forming an additional guard rail along these places. The round shape of these logs, it is thought, will effectually prevent the car wheels from mounting them. Added to all these precautions along the track, the cars are fitted with air brakes in addition to the regulation hand brake, the wheels have extra deep flanges, and the cars are always run at slow speed—not only on account of safety, but also to allow passengers to appreciate the scenic effects.



A BIT OF THE LOWER END OF THE GORGE.

In the overhead construction very few poles were needed on the cliff side of the road, the span wires being tied to stumps of trees on the steep overhanging banks, or fastened to I bolts let into the solid rock. The difficulty in setting the poles on the outer side, however, more than offset the saving effected on the shore side,

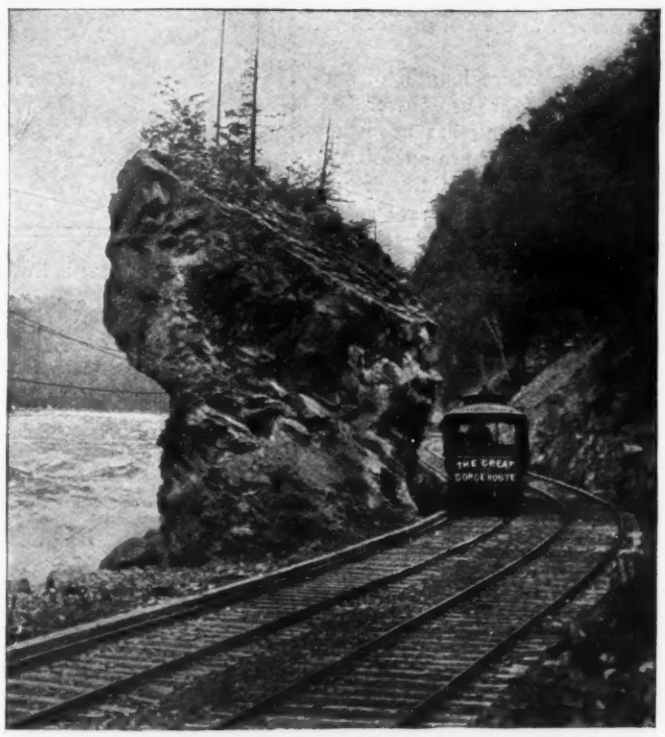
ONE OF THE CURVES—LOOKING DOWN THE GORGE.

owing to the number of boulders and steep banks where the poles had to be braced.

A 00 trolley wire is used for the entire distance of the route, this being fed for the first three miles from the power house by a heavy wire of 500,000 c. m. section; the next two miles being of 0000 wire, and the last two of 000 wire. At intervals of 2000 feet are placed cut-out switches with independent circuit breakers, in order that the service may not be interrupted by any stoppages along the line.

The rolling stock of this company consists, at present, of twenty-seven open and three closed cars, to which five more open cars will shortly be added. They are built by the J. G. Brill Company, are thirty-four feet long, and have twelve reversible seats. The trucks are of the maximum traction type, and are equipped with two 50-hp Westinghouse motors; the whole electrical car equipment having been furnished by the Westinghouse Company. During the Summer of 1896 power was supplied from two small generators belonging to the Niagara Falls Hydraulic Power & Manufacturing Company, but when the new station was put in operation power was taken from two 750 hp General Electric machines.

This brings to our notice another feature of this interesting road. Not only has the falls of Niagara carved out some of the most picturesque scenery for the benefit of the present and future generations, but it is now called upon to supply the motive power to enable sightseers to traverse the rocky canon. Nearly forty years ago an hydraulic canal was dug from a point a mile above the falls to the river bank, a short distance below the present Suspension Bridge. For many years this was used to supply water power for paper and flour mills situated along the bank, and in 1892 the company began to enlarge and improve it, foreseeing that the rapid development of electricity would soon enable them to make more use of their power. In November, 1896, the present power station was completed and put in operation. Great difficulty was experienced in obtaining a foothold for this station on the lower bank of the river, the cliffs approaching so closely to the water's edge that it was necessary to blast over 60 feet into the side of the cliff. The building was constructed of the limestone thus removed, which proved to be of very good quality for the purpose. Its width is 100 feet, and the present length about sixty feet, provision having been made for an extension. Two hundred and twelve feet above is the forebay into which the water flows from the canal before mentioned. From the forebay is led a penstock eight feet in diameter, which has a clear fall of 125 feet and then extends, at an angle of about forty-five degrees, to the power house, making a total available head of 206 feet. It is then expanded to about twelve feet, and carried under the power house for its entire width, tapering at the end to about two feet. At this point is attached a vertical cylinder twenty feet long and three and one-half feet in diameter, which, being filled with air, acts as a buffer to prevent too great a strain on the penstock in case of sudden stoppage of the water flow. As an additional precaution eighteen relief valves are attached at this point, these valves being set at 120 pounds pressure, while the normal pressure in the penstock is about eighty-five pounds. Five-foot valve gates weighing twenty tons each let the water into the turbines, there being a by-path eighteen inches in diameter for each of these, to allow of filling the water wheels before turning on the main gates. Running under the penstock and emptying into the lower river is the tail race, cut out of the limestone bed and seventeen and one-half feet in width. Four Leffel turbines of the horizontal type are supplied from this penstock, three of them being of 1700 horse-power each, running at a speed of 250 revolutions per minute. The valve gates are operated by hydraulic pressure. Water-power thus supplied is furnished to the Pittsburg Reduction Company, who own and operate six 750-hp Westinghouse dynamos, the current being used in their mill on the upper bank for reducing aluminum. In connection with these machines one interesting feature is noticeable—there are no automatic governors attached to the water wheels. As a steady load is taken from these machines, it was not thought necessary to make use of them. The gates being operated by hydraulic pressure make the operation of starting and shutting down the entire plant so easy that only one man is needed even in an emergency case. The fourth turbine is of 2000-hp capacity running at a speed of 300 revolutions per minute. It is controlled by a Lombard hydraulic governor, which is said to be the first of the kind ever successfully operated. At the time of the installation objections were made to this governor, it being claimed that the river water corroded iron so rapidly that the pipes and valves would be constantly getting out of order, but the last six months' experience has proven it to be perfectly satisfactory. The regulation is so close that the voltmeter charts, on the mains of the generators driven by this wheel, show a variation of less than 3 per cent. At either end of the shaft is connected a 750-hp General Electric dynamo, supplying direct current at 525 volts. About 300 horse-power is furnished the Gorge line from these machines, and by means of a General Electric "booster," 75 horse-power, at a pressure of about 750 volts, is also furnished to the Lewiston & Youngston Frontier Railroad, a railway which connects with the Gorge line at Lewiston and runs to Fort Niagara at the mouth of the river. The rest of this power is used by the mills and factories on the upper bank.

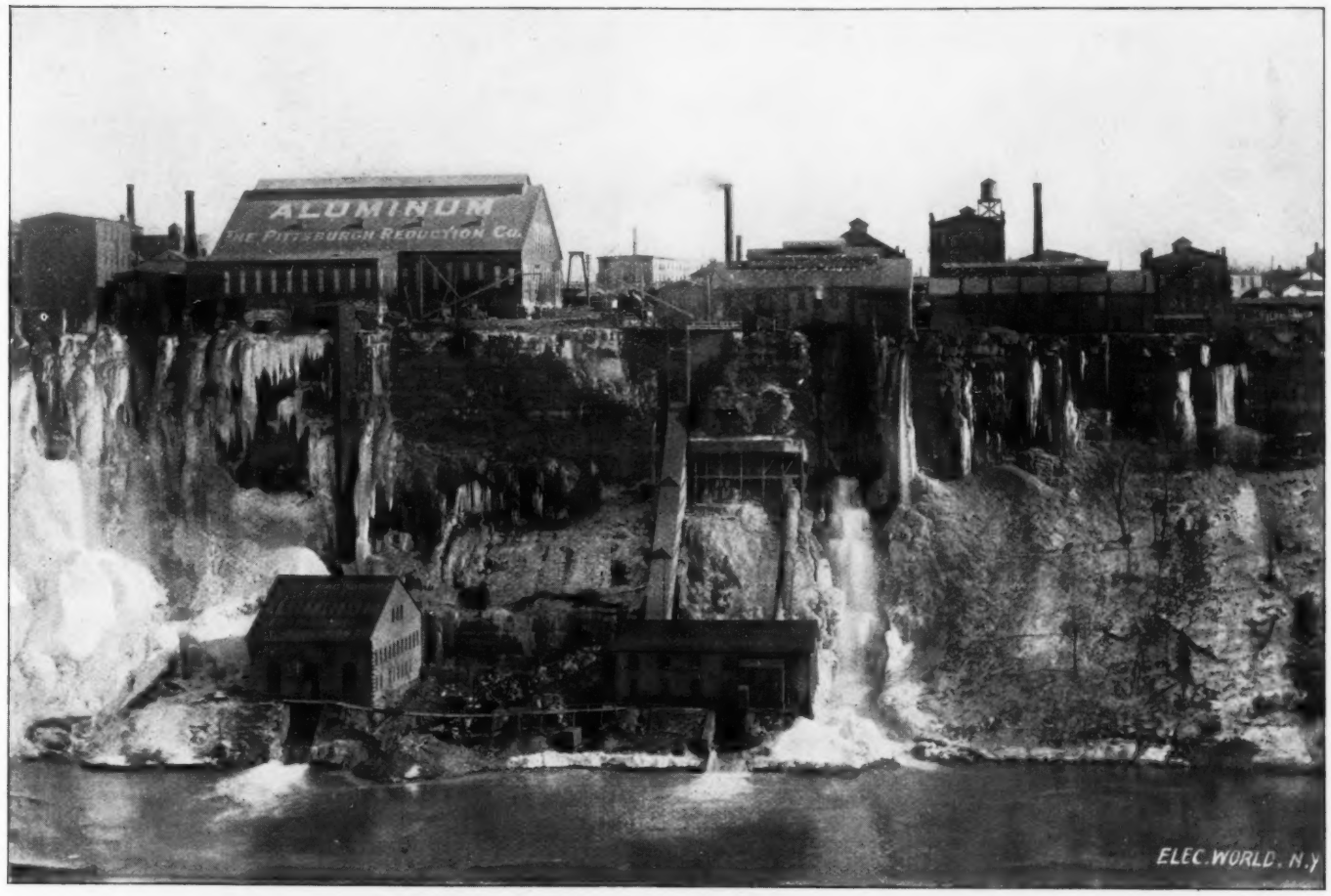


Curve Around Sentinel Rock.

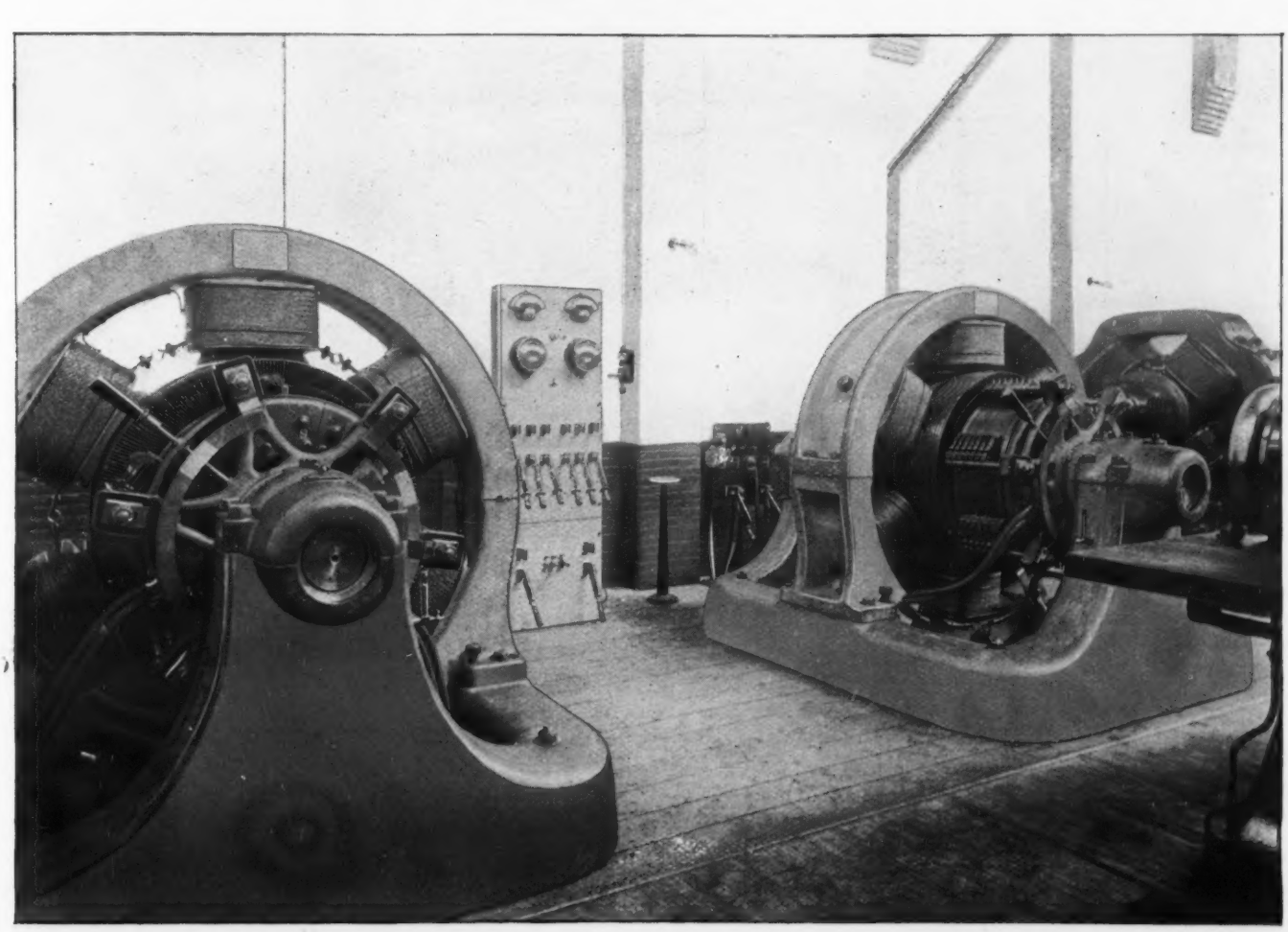
Within six months the dimensions of the present power house will be doubled. The Hydraulic Company has already blasted out sufficient space to permit of an extension sixty feet long. Running across this space is another tail race twenty-two feet wide, which is designed to carry off the water which will be supplied from a penstock ten feet in diameter. By blasting further into the side of the cliff they will be enabled to carry this penstock down vertically the entire length. It will furnish power to six water wheels of 1700 horse-power each.

Considerable trouble was experienced in installing the machinery. As everything was delivered at the top of the bluff, it was necessary to lower the machine parts—some of them weighing nearly twenty tons—to the river bank below, and this had to be accomplished by a swinging derrick. Such operation, of course was extremely hazardous, but, owing to the excellence of the management, no accidents were recorded.

In no other part of the world has a greater demand been made upon the knowledge and skill of railway and electrical engineers than in the construction and operation of this great roadway. Although it was built solely for tourist travel, as much care was necessary as in the construction of any of the great railroads in the country—not even excepting the wonderful piece of engineering in the Grand Canon of the Arkansas, the most daring feat in the railroad history of the United States. In the war with nature science has conquered, however, and to-day thousands of pleasure-seekers are enjoying at their leisure the most beautiful and varied scenery crowded into a space but seven miles in length.



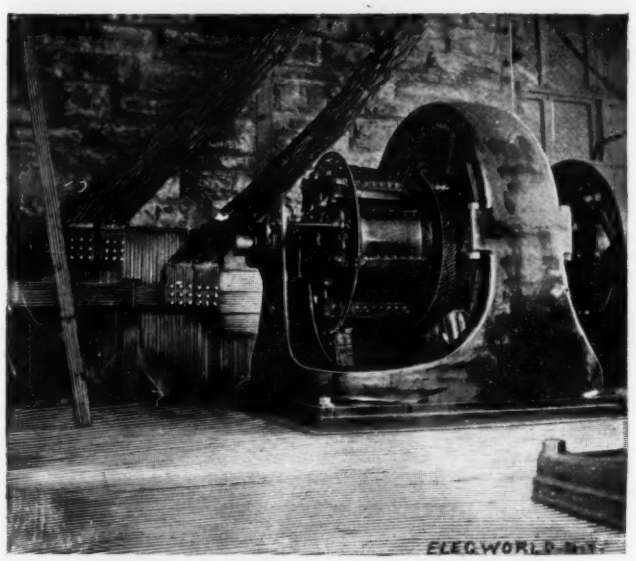
VIEW OF NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING COMPANY'S STATION FROM CANADIAN SIDE.



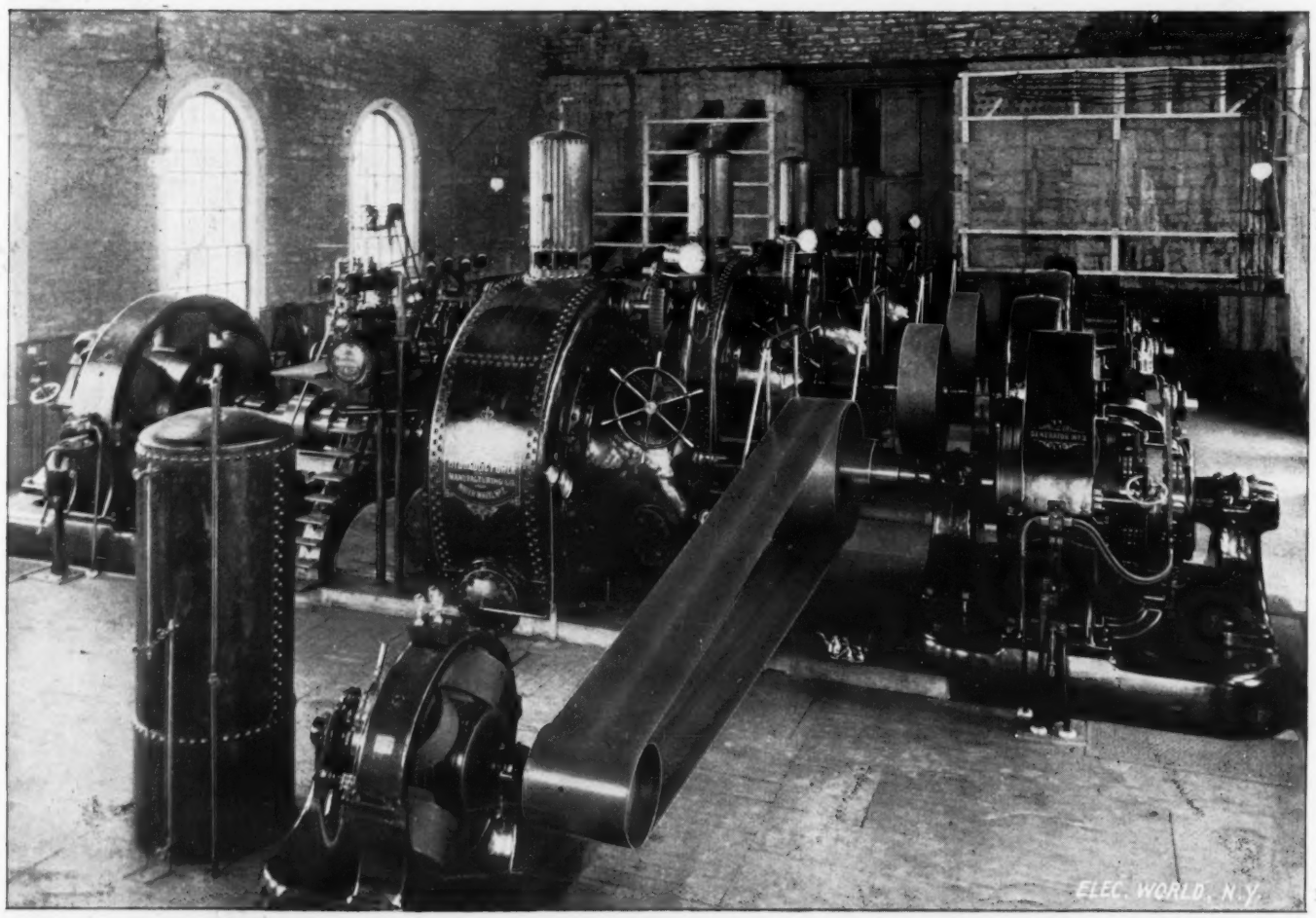
ROTARY CONVERTERS AT BUFFALO END OF TRANSMISSION LINE.

Niagara Falls Hydraulic Power & Manufacturing Company.

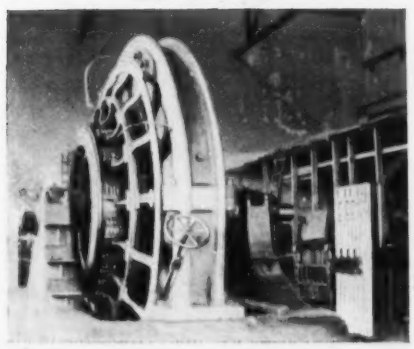
IN the great canon or gorge below the falls is situated the power house of the Niagara Falls Hydraulic Power & Manufacturing Company. This development of Niagara Falls power is the outgrowth of the earliest that was made. The so-called hydraulic canal was constructed over forty years ago, and for a long time furnished power to flouring mills located on the bank of the gorge. Taking its water about a mile above the American fall this canal, which is nearly 100 feet wide, runs to a point on the cliff about a quarter of a mile below the falls. Thence the water is led by a steel penstock of very solid construction to four Leffel turbines, operating under a head of 206 feet, situated at the base of the cliff on the bank of the river. At the bottom of the penstock is attached a vertical cylinder 42 inches in diameter and 20 feet long, which is filled with air and acts as a buffer to prevent the shock and strain on the penstock that would follow the sudden stoppage of the flow of water. The normal pressure at the bottom of the penstock is 85 pounds per square inch, and as additional precaution the base of it is supplied with eighteen relief valves set at 120 pounds pressure. The tail race is quarried out of the limestone, and is 18 feet in width. The control of the turbines is very peculiar. Those which are used for generating the steady current for the Pittsburg Reduction Company are not provided with governors, seeing that their load is perfectly constant. The wheel used for generating the railway current is provided with a Lombard governor, the first of its kind ever operated. These turbines are used in part for the generation of current for the use of the Pittsburg Reduction Company in the manufacture of aluminum, and for the supply of current to the Gorge railroad, and to several mills and factories, in the manner described elsewhere in this issue. An extension which con-



One of the Direct-Current, 560-kw Generators and Aluminum Conductors.



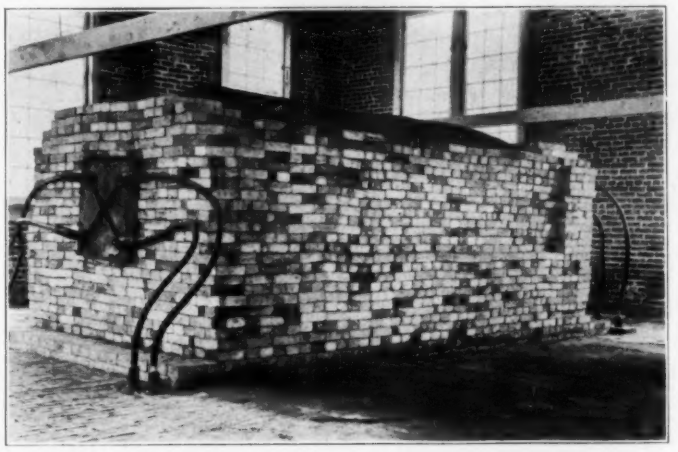
Interior of Niagara Falls Hydraulic Power & Manufacturing Company's Station.



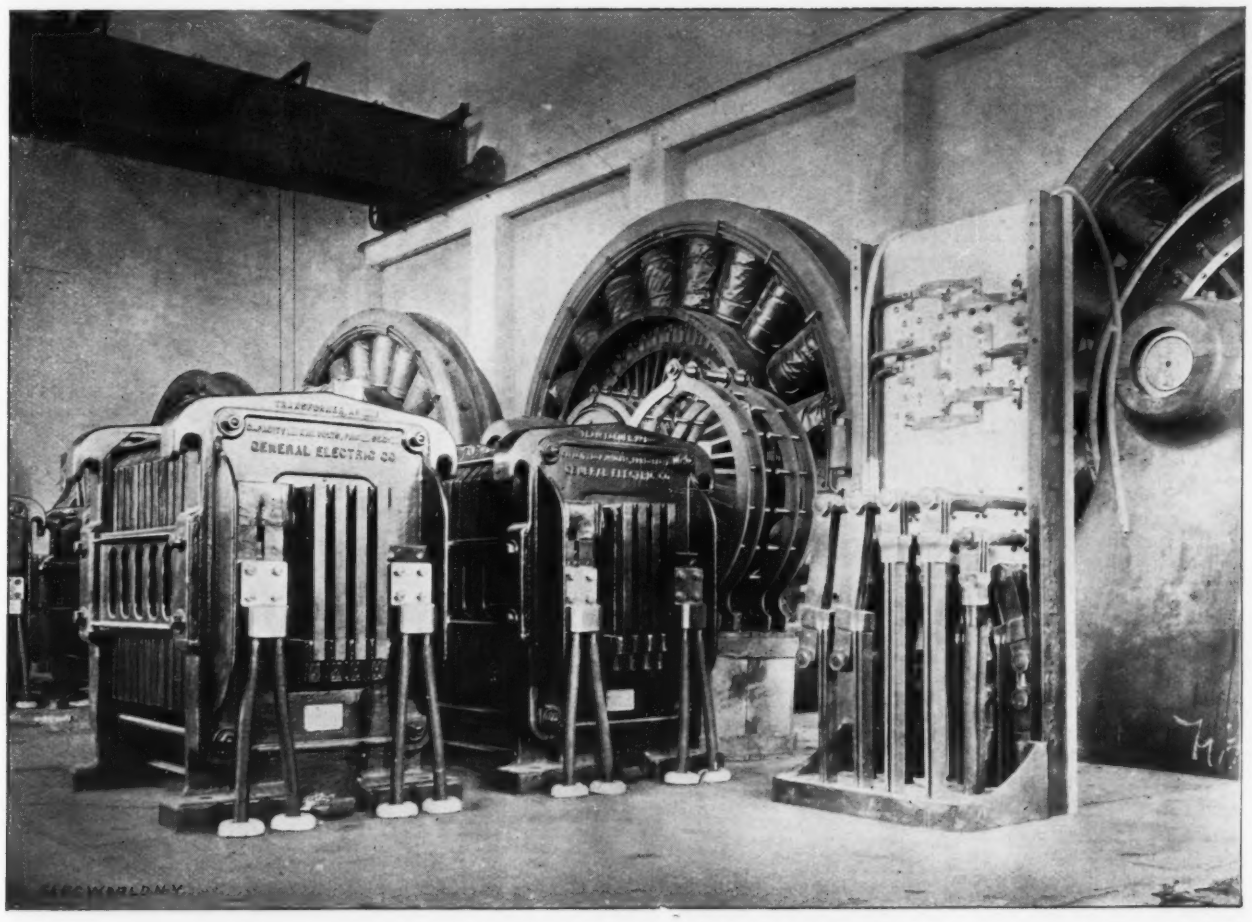
Direct-Current Side of Rotary Converter, for Aluminum Smelting, Pittsburg Reduction Company's Works.

sists of five turbines, each of 2000 horse-power, is well under way. The new flume which is now being constructed to supply these turbines will be of unprecedented size and will be constructed of steel 1¼ inches thick. It has not yet been divulged what use will be made of the 10,000 horse-power which is to be generated, except that it will be converted into electricity and utilized through that agency, but it is generally believed that it will be utilized in a new electro-chemical industry.

The tremendous impetus that has been given to the operations of this company by the installation of electrical apparatus is worthy of note. For nearly forty years, nothing was done with the gigantic power available at the point where their works are located other than the grinding of flour, and the manufacture of paper by the Cliff Paper Company. Now that electrical transmission has added a new means to those at the disposal of engineers this plant has increased greatly in size and is already a formidable competitor to the Niagara Falls Power Company, which operates the hydraulic tunnel.

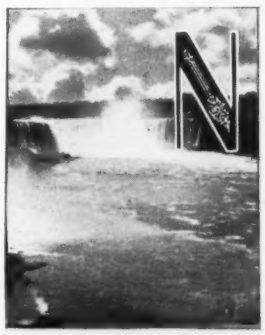


ELECTRIC FURNACE FOR MANUFACTURE OF CARBORUNDUM.



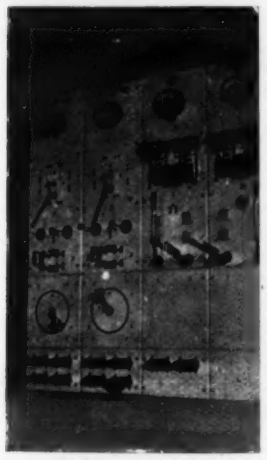
TWO STATIC TRANSFORMERS, 2200 TO 115 VOLTS. FOUR ROTARY CONVERTERS, 115 VOLTS, ALTERNATING TO 160 VOLTS DIRECT CURRENT PITTSBURG REDUCTION COMPANY.

The Carborundum Company.

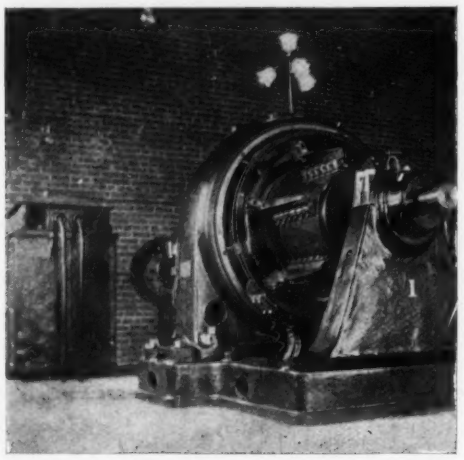


NOT the least notable of the electrical industries which have clustered about the great cataract is the Carborundum Company. The product which this corporation is engaged in making is particularly interesting to electricians, since it is one of the new materials which the electric furnace and electric methods have given to the arts. Carborundum is an abrasive substance similar in its properties to emery and corundum, and is manufactured by subjecting a mixture of salt, glass-sand, sawdust, and powdered coke to the intense heat of the electric furnace. Its composition is silicide of carbon, and, with the single exception of diamond, it is the hardest known substance. The furnaces in which the operation takes place are built of loose bricks, since no mortar could stand the intense heats to which they are subjected, and also because of the need for ample vents for the gases generated during the operation of the furnace. At each end of the brick furnace is a bunch of large carbon rods connected by a massive bronze terminal to the cables leading from the transformer. The furnace is filled with the mixture described above and along the line between the two terminals, in the axis of the furnace, is placed a core built of coke. This core is about 15 feet long and 20 inches in diameter and weighs over 1000 pounds. The current to the extent of 1000 horse-power is received from the great dynamos of the Niagara Falls Power Company at a potential of 2200 volts, alternating. It is passed through a transformer, giving an initial pressure in the secondary of 250 volts, which is further controlled by means of a gigantic reactive coil, which permits it to be cut down to 100 volts. When the current is first applied to the

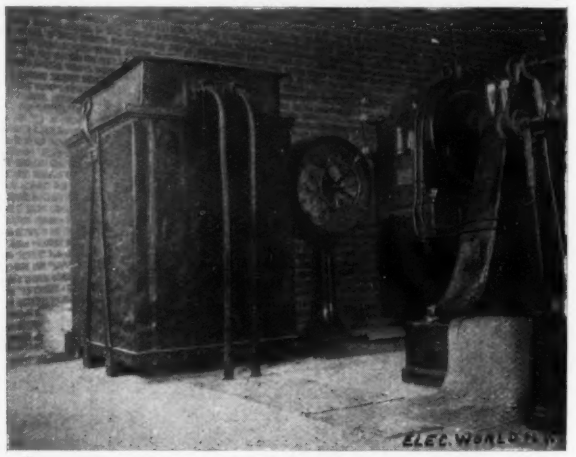
furnace, at the maximum voltage, the core rapidly heats, and its resistance correspondingly decreases until the maximum flow of current is attained—generally well over 1000 amperes. This, of course. enormously heats the core, which with its increasing temperature becomes of still less and less resistance, requiring the current to be lowered by means of the reactive coil. After two or three hours of running, the furnace begins to give out gases, which catch fire at the exterior and burn above the top of the loose pile of bricks of which it is constructed. The operation is not entirely without its dangers, as, in the second stage of the process, which is accompanied by the appearance of yellow flames over the top of the furnace, the whole structure has been known to explode with great violence. The sawdust, for some inexplicable reason, seems to lessen the danger of these explosions and render the operation more even and continuous. The duration of the heat for each furnace is about twenty-four hours. At the end of this time, the current is cut off and the furnace allowed to cool, which may take about half a day. When it is cool enough to work in the brick walls are taken down and around the inner core is found an outer crust of carborundum in an amorphous form and an inner crust of crystalline carborundum. The uses of this substance in the arts have been manifold, and are likely to increase as its value is further disclosed.



Switchboard for Rotary-Transformers.

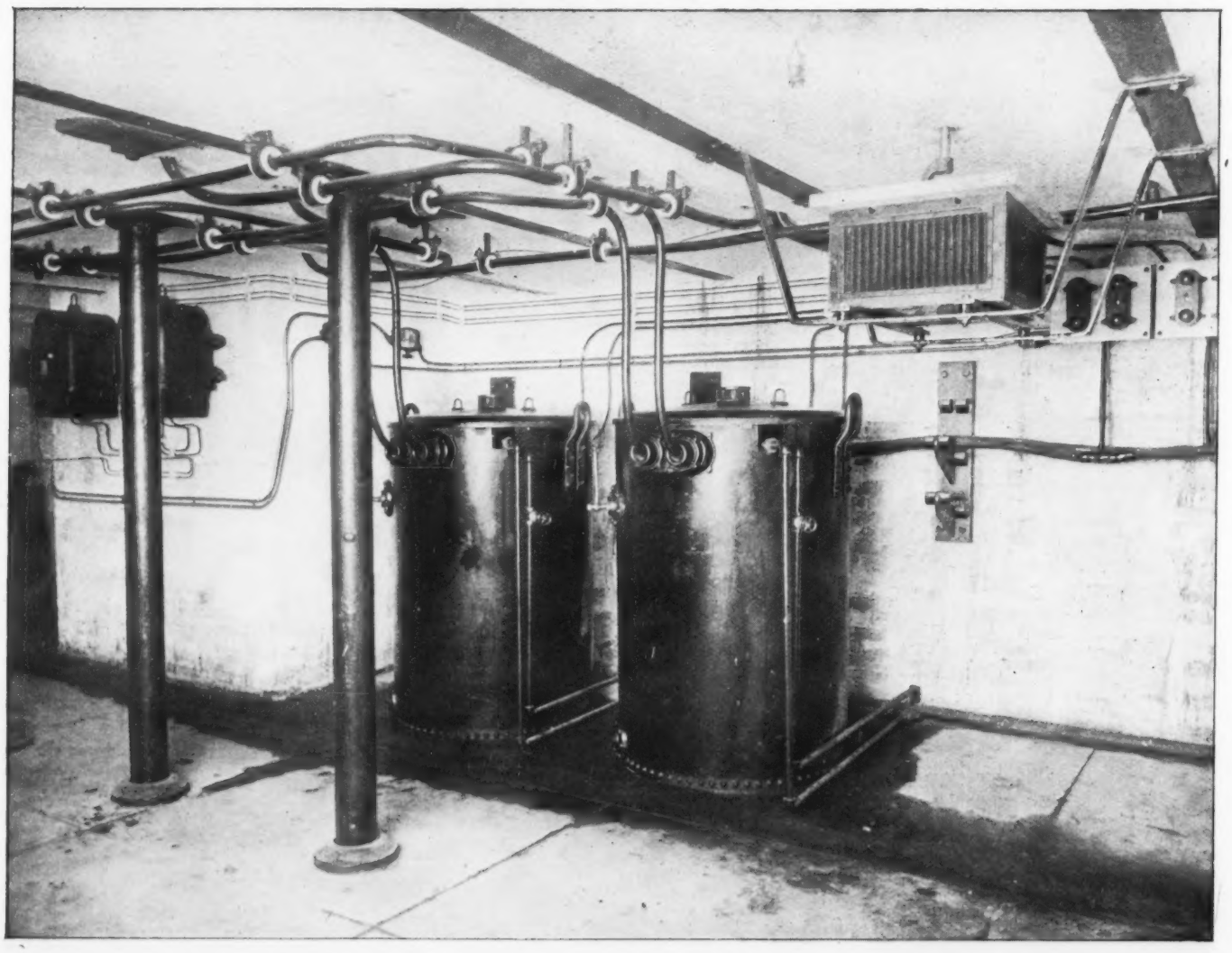


250-kw Static and Rotary Transformers, each 2200 Volts to 116 Volts.



Static Transformer, 2200 Volts, Two-Phase, to 118 Volts, Direct Current.

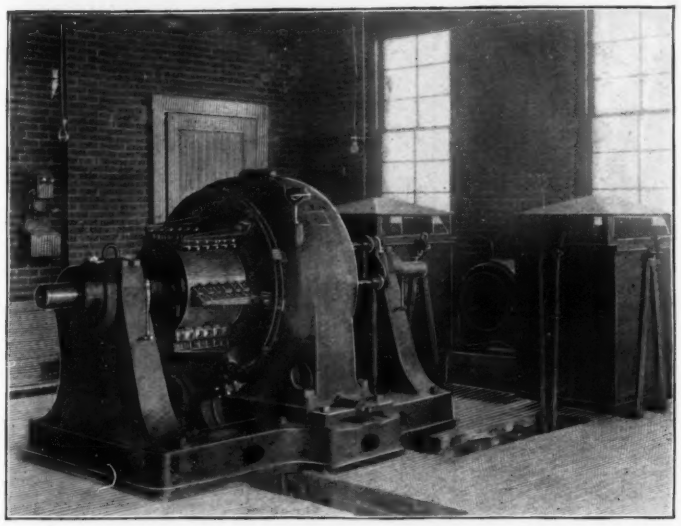
Apparatus in Niagara Electro-Chemical Works.



Static Transformers, 2200 to 400 Volts, in Niagara Falls Power Company's Station.

The Electrical Manufacture of Sodium.

THE Niagara Electro-Chemical Works is using the current from the Niagara Falls Power Company for the electrical manufacture of sodium. The process used is that known as the Castner process, and reduces the metallic sodium from caustic soda and soda peroxide. At present this plant is consuming about 750 horse-power of current, receiving 2200-volt two-phase current from the large generators in six static transformers, which reduce its potential to 118 volts. This current is led to three rotary transformers of 250 horse-power each, which convert the alternating current into a direct current of 116 volts, at which pressure it is fed from the main switchboard to the various apparatuses used in the manufacture of the metal. The third of these rotaries has recently been installed, and is probably the first of its kind in operation.



NEW ROTARY CONVERTER IN THE NIAGARA ELECTRO-CHEMICAL WORKS.

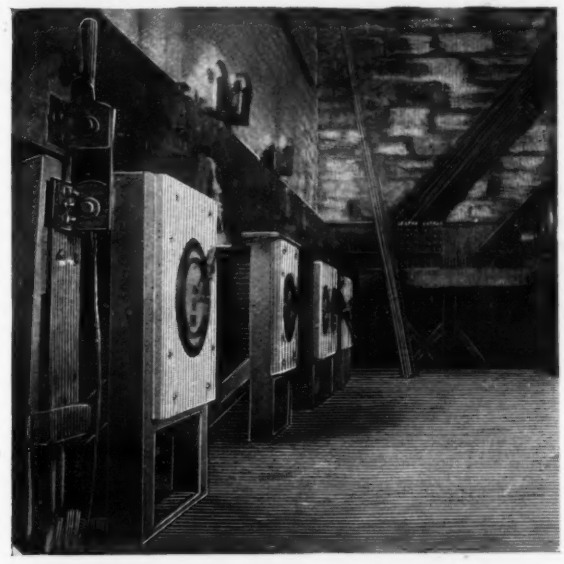
It is unique in that it has no field coils whatever, the field magnetism being induced by the armature. The machine, in most respects, is similar to other standard apparatus, except that the space between the armature and pole pieces has been reduced to about one-sixteenth of an inch. It is self-starting, very efficient, and is intended to supply current at a voltage varying from 125 to 165 volts; the voltage being controlled by an ingenious regulating device used in connection with the static transformers, which reduces the pressure of 2200 volts on the mains to a voltage ranging between about 100 and 140. The Westinghouse Company designed and manufactured this machine.

The Electro-Chemical Company at present are running their machines independently—each machine supplying a separate line of pots—but it is expected that there will be no difficulty in running this machine in parallel with the other rotaries.

DIRECT-CURRENT SWITCHBOARD AND BUSES, PITTSBURG REDUCTION COMPANY.

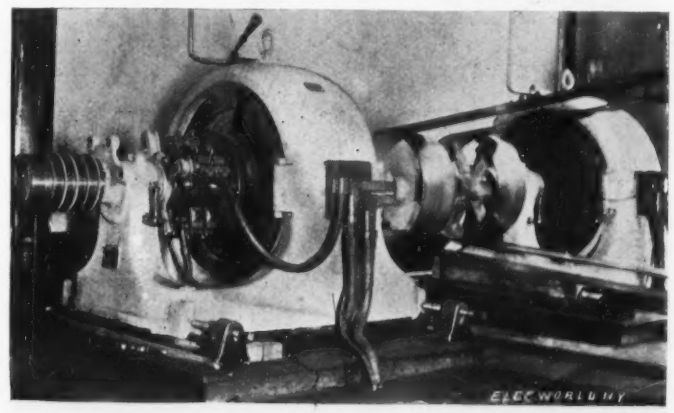
Calcium Carbide.

ACETYLENE gas, which has been talked about for some time past as a possible rival to electricity for illuminating purposes, is easily manufactured by the simple process of mixing calcic carbide with water. A feature of peculiar interest in connection with this process for the manufacture of the so-called rival to the incandescent light is that the calcium carbide, upon which its commercial manufacture largely depends, is the product of the electric furnace, and can only be commercially manufactured by the aid of electricity. The Acetylene Light, Heat and Power Company, which is engaged in the manufacture of this interesting compound, is one of the large users of power from the Niagara Falls Power Company.



COPPER BUS BARS, 8000 AMPERES, AND ALUMINUM CONDUCTORS.

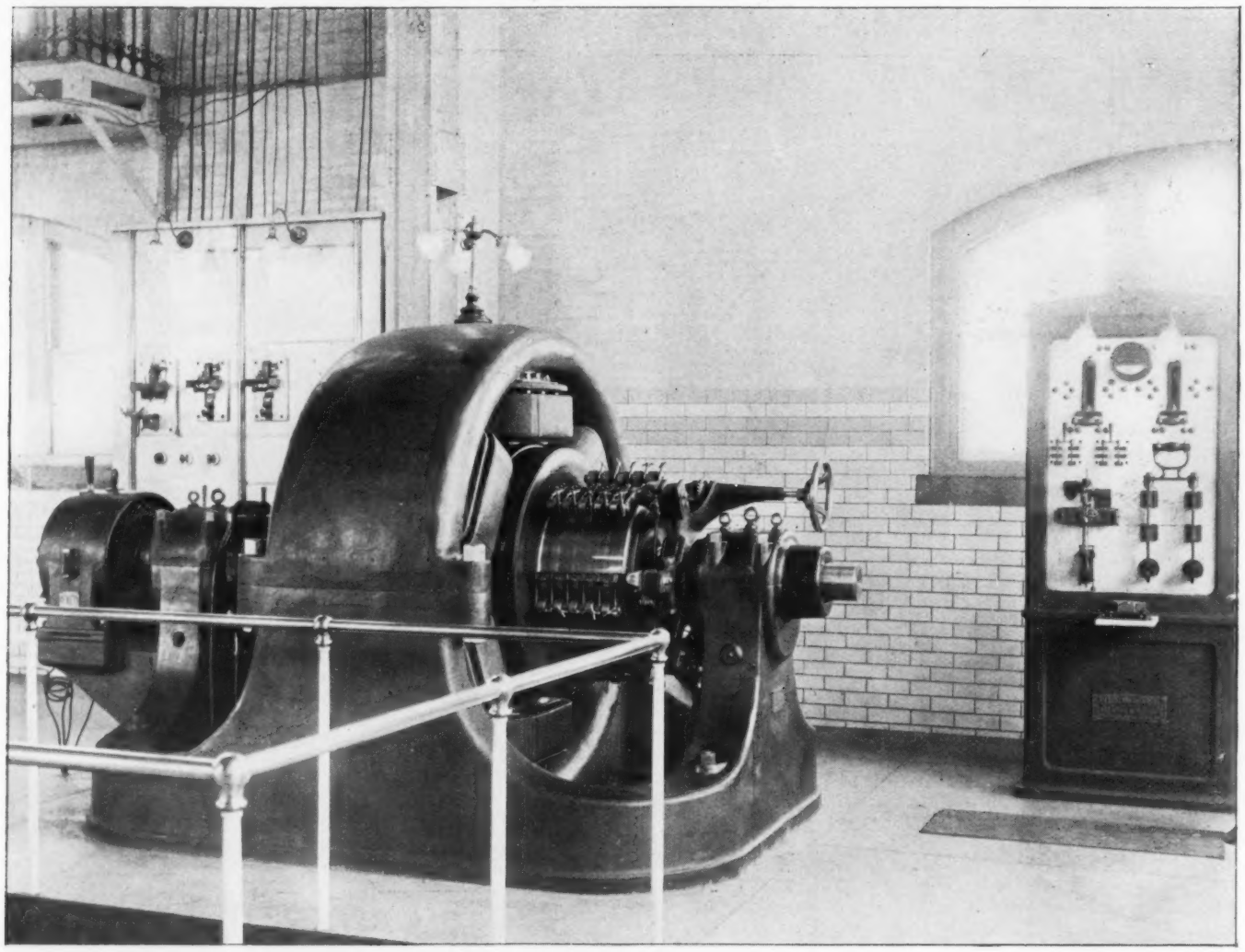
At this time they have in use about 1000 horse-power, but their business has been increasing at such a rate that they are about to install an addition of 5000 horse-power for use for their furnaces. The power is received at the dynamo potential of 2200 volts alternating in static transformers, which reduces it to 100 volts. The



30-KW ROTARY TRANSFORMERS IN BUFFALO REAL ESTATE EXCHANGE.

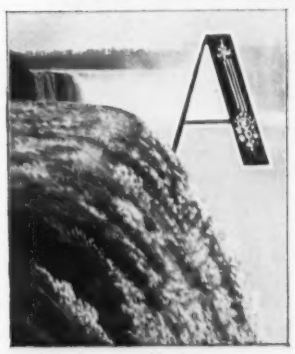
process of manufacture is extremely simple. The furnace consists of a brick structure into which can be rolled a small iron car. The bottom of this is made of cast iron, and so arranged that when it is in place in the furnace it can be securely connected to a terminal, which leads to one side of the secondary of the transformers. The sides of the car are made of plate iron. When the car has

been put in place in the furnace and connected, a carbon rod is lowered by means of an ordinary pulley until it touches the bottom of the car, when it is lifted. This carbon rod is connected to the other side of the secondary circuit, and the result of its manipulation is the establishment of an arc carrying about 2500 amperes at 100 volts. The mixture which is subjected to the heat of this arc is then allowed to run into the car through an arrangement of chutes. The compound consists of a mixture of about three parts of lime to two parts of ground coke. The calcic carbide rapidly forms in a lump on the bottom of the car and shortens the arc, which is regulated to its proper length and resistance by drawing up the carbon rod. It was not found necessary in this plant to use any choke-coils or methods of controlling the current other than the simple manipulation of the arc length. A full charge of mixture results in the formation of about 800 pounds of carbide, which is generally in one large mass. This is broken up into smaller pieces and packed in sheet iron barrels containing about 1000 pounds, and it is also put up in smaller packages. When the furnaces are in operation the roar of the 2500 ampere arcs, operating on the low frequency of 25 periods per second, is deafening and conveys to the listener in a curiously striking way an idea of the enormous power of the currents that are used. The method of conducting the secondary current to the furnaces is interesting because of the effort to eliminate the inductive drop on the circuits due to the passage of the almost unprecedented currents used in this industry. The conductors are made of strips of copper, which are placed side by side, the alternate strips being of opposite polarity.



One of the Rotary Converters for Railway Feeding in the Niagara Falls Power Company's Station.

Other Uses of Niagara Power, Present and Future.



AMONG the various uses of power not fully described in these pages may be mentioned 500 hp supplied to the Buffalo & Niagara Falls Electric Light & Power Company, which is used for lighting the city of Niagara Falls, and 150 hp of direct current, which is used for local power work. The Niagara Falls Water Works uses about 50 hp, and the Hygeia Ice Company in the same city about 50 hp at 500 volts, which is supplied by rotary converters at the power house.

The prospective uses of Niagara power lie mainly in the field of prophecy. At present about 3200 horse-power, in addition to that already in use, is to be applied almost immediately in the manufacture of caustic alkali and other chemicals, and for grain elevating in the city of Buffalo. The possible uses of this power afford a field of conjecture which is most tempting. The present colossal developments, wonderful as they are from many points of view, can only be regarded as the forerunners of others vastly more important, until in time a large proportion of the power of the mighty cataract will be made subservient to the uses of commerce in ways which it is not now possible even to foresee. This is scarcely less true of the city of Buffalo, which already receives power for the operation of its street railways from the cataract. There seems to be no reason why a much larger amount of power should not be economically and satisfactorily sent to Buffalo and the Falls, nor is there any reason to suppose that the present installations have shown the best that can be done in the way of economical and safe power transmission. The limit of the utilization of Niagara will probably be reached whenever the amount of water withdrawn from the falls begins to seriously affect their appearance, but that this is a long way in the future can readily be judged when it is considered that the aggregate total horse-power of the Niagara River at this point is nearly three million.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Theory of Three-Wire Machines. RASCH. *Elek. Zeit.*, May 13.—A communication referring to the article by Rothert (see *Digest* last week). The alleged advantages over the Dobrowolsky system he claims are only of theoretical importance, as the latter system regulates well for differences of load of more than 10 per cent. and in any well-installed system the differences are seldom more than this; he also points out that there may be greater differences in the balancing in different parts of a net work, but that they tend to balance each other, and this involves a larger neutral wire; the Rothert machine cannot take care of such differences any more than any other system could.

Tri-Phase Machinery. HANAPPE. *L'Eclairage Elec.*, May 8.—A continuation of the description of the laboratory instruments at a school at Mons, the special features of which are the arrangements for using them for instruction; in the present portion the motor is described with the aid of a large number of illustrations.

Direct Current Transformer. THORDARSON. *West. Elec.*, May 29.—A reprint of a Chicago Electrical Association paper. He believes the continuous current is the ideal method of transmitting electrical energy, and discusses the direct-current transformer; there is considerable field for improvement in these by reducing the cost of attendance. He discusses the friction and sparking, pointing out the differences in transformers and dynamos; the magnetic field may be so designed that the armature will be absolutely free from lateral thrust and the pull of the field will be almost entirely counterbalanced; he describes a 200-watt transformer designed a year ago which has been running very satisfactorily; he also tried the idea of rotating the brushes, keeping all the other parts stationary, and shows that the method must be considered practically worthless.

Heating of Armatures. MOFFAT. *Elec. Eng.*, May 26.—A short article containing a curve showing the waste in watts for different ranges of temperature, as obtained from a test which he made; it shows that at the higher temperatures the power lost is surprising; another curve shows the waste as the output is increased; he points out the probable causes of the heating, and claims that the discs are often not as well insulated as they should be; he recommends varnishing them.

POWER.

Transmission of Power in Factories. CLIREHUGH. Lond. *Elec. Eng.*, and begun in *Elec. Rev.*, May 21.—The beginning of a reprint of a Northern Society of Electrical Engineers paper; it refers more particularly to factories devoted to the textile trades; much of it is a review of what is already known; he points out some of the difficulties and methods of avoiding them. He favors a direct-coupled plant of moderate speed and a multipolar dynamo; such a combination will give a kilowatt hour with 30 to 32 pounds of water, or one indicated hp with 18 to 20 pounds or 2.5 pounds of coal; he favors the Royce time fuse for motor work, which will allow the motor to be overworked for a short time only, say for three minutes, without blowing the fuse; a machine should be tested for power under all the varying conditions, the importance of which he illustrates. He favors about 1000 revolutions per minute for the motors and discusses the gearing required; the best cut spur wheels should not run at a greater speed than 1800 feet per minute; he has had very good results with worm gearing and gives the results of some tests made with identical machines, one driven by a worm and the other by a belt, from which he concludes that the efficiency of the two forms would be practically equal. He urges very strongly the use of enclosed water-tight motors if the location is damp, as they are well worth the additional cost; in these he warns against the use of carbon brushes, as the temperature cannot be kept down; he recommends wire brushes. He recommends running without resistance at the normal speed and lowering the speed with resistances in series with the armature; water resistances are not suitable; he recommends a distribution switchboard with an ammeter capable of being connected with each circuit and by means of which anything wrong with any of the machines is readily indicated. In conclusion he discusses the first cost and efficiency of electric driving, the former of which he admits is high; the figures are based on actual work carried out.

Local Distribution in Workshops. SCOTT. Lond. *Elec. Eng.*, May 21.—A continuation of his long serial; he begins the consideration of alternating currents. About 4,000 volts has been the limit for continuous currents, and with alternating no serious difficulty has been had with 15,000; the Lauffen-Frankfort transmission plant cost about $300 per hp, of which 80 per cent. was required for the cables and fittings; for a factory the cables will probably not cost more than 35 per cent. There is a considerable saving in copper, using continuous currents, which he shows in a table giving the views of Georges, Kapp, Kennelly, Steinmetz and others and based on sine curves; in practice a sawtooth form is generally preferred to save iron losses in the transformers; for factory driving the three-wire continuous current saves copper; secondary considerations are involved such as the cost of the insulation, which is almost as much as that of the copper and comes into account in increasing the number of the wires; the cost of erecting also increases with the number of wires; regarding the frequency, he concludes after considering everything that 50 periods per second is about the best compromise for combined motor and light work.

Utilizing the St. Lawrence at Massena.—Lond. *Elec. Rev.*, *Elec. Eng*, and *Elec.*, May 21.—A short article on the proposed plant at Massena just north of New York State, where the St. Lawrence River is about 50 feet higher than the Grass River, which flows nearly parallel to it at a distance of 2.5 miles from it; by connecting these with a canal the St. Lawrence can be made to discharge into the Grass River; a map is published and the first two journals contain drawings of the proposed plant. It is proposed to charge $12 and $15 per electrical hp per year, which is probably the cheapest price at which electrical energy has yet been sold.

Gas Engine Plant. LANGDON. Lond. *Elec.*, May 21.—A communication giving some data for the plant of the Midland Railway Company for lighting the station at Leicester, the results of which are very favorable. The total hp is 250 and the plant is driven by two Dowson gas generators using anthracite coal costing $4.12 per ton; the total expenditure covering all charges except interest, taxes and land was for the half year 6.34 cents per kw hour; the price paid for fuel does not materially differ from that at Coatbridge, but the result per unit is 2.9 cents for Coatbridge against 0.41 for this station; the low tension direct current machines are run in parallel whenever needed and batteries are not used. In an editorial notice it is stated that no steam driven station can approach this in its fuel economy but that unfortunately other items of expenditure are not so favorable; the repairs items are much higher, showing that the principal expenses in gas engine driving are due to wear and tear of machinery, to excessive lubrication and to the cost of labor. In a communication by Pertwee he calls attention to the large amount of oil and waste used in a gas-driven plant; the oils even after filtering are of no great value, as they are mixed; the production of good gas is also widely different from the production of steam, and there is also a great uncertainty in starting the engines.

Gas Engine in Central Stations.—Elec. Eng., May 26.—An editorial abstract of the article which was noticed in the *Digest* May 22, and which referred to the Coatbridge England, plant where steam replaced gas after a trial of 15 months.

Electric Lighting by Gas Engines. RICHART. *West. Elec.*, May 29; a reprint from the *Technograph*. It deals almost exclusively with gas engines and allied apparatus.

Middlesex, Vt.—Elec. Eng, May 26.—A very brief illustrated description of the plant in which there is an available motive power of 2,500 horsepower; there are two 150 kw three-phase alternators running at 2,500 volts which will be raised for transmission to 10,000 volts.

Locomotive Turntable.—Eng. News, May 27.—An illustrated description of the one at the West Milwaukee shops which has been in use for some months and on which seven locomotives per hour are turned; there seems to be considerable economy over the old method of turning by hand.

TRACTION.

Shunt Motor for Traction. LUXENBERG. *Elek. Zeit.*, May 6.—An article against shunt motors, and comparing the relative advantages and disadvantages of the shunt and series motors; it is based on the article by Baxter published in the ELEC. WORLD Dec. 12, 1896, page 720, and is an unfavorable criticism of it; he claims that that author is not a practical engineer and that he is too theoretical. That a fine wire winding is less durable is not true; the extra cost of the shunt winding is such a small portion of the whole that it need not be considered; the reasons why shunt motors have not been adopted must therefore be looked for elsewhere; the limits for variations in speed, torque and efficiency are the same for series and shunt

motors, as the first and last depend on the magnetic field alone; he discusses at some length the claim that energy can be restored to the circuit in going down hill with the aid of shunt motors and makes a number of calculations to find the possible economy; the magnets would have to remain excited and it will take a grade of 1.5 to 2 per cent. before any useful energy would be restored to the line; but grades above 2 per cent. are generally few and short; the amount of restored energy is therefore very slight and the saving would be only in coal and water; the magnets would have to remain excited even when the car is at rest; a recovery of current on down grades involves a greater cost of repairs, brushes, gears, etc., and it is quite possible that this increased cost would be more than the amount gained; on steep grade rack or cable lines, the gain might be appreciable; at present shunt motors are used only on one such a cable line at Barmen; the braking action is of no importance, as a mechanical brake would have to be provided in any case; furthermore the braking action at a slow speed is practically nothing; all methods of braking other than the mechanical are more expensive as the wear on the gears, brushes, commutator, etc., is greater; the return of energy in stopping the car is as impracticable with the shunt as with series motors, as it will be converted into heat just as in the mechanical brake; as there is practically no return of energy the saving in the line is of no importance; that the speed of the shunt motor is independent of the voltage would be of importance only on long lines and a variation of the voltage would interfere with the lighting; there remains therefore practically nothing in favor of shunt motors. Among the disadvantages he states that the magnet circuit can only be broken slowly on account of the self-induction and the circuits would therefore not be opened during short stoppages; to provide for breaking this current special means will be required; on connecting the armature at high speed down hill, dangerously high voltages would be generated; the series-parallel connections cannot be applied; the effect on telephone wires would be greater; the advantages of mounting heavy grades with relatively small currents would be lost; the two methods which Baxter gives are not practical, partly on account of the high self-induction of the magnet winding and on account of the large amount of resistance wire required; the magnet wire would have to be larger in diameter, which greatly increases the cost; the Sprague method is the very one which is not practical for shunt motors.

Electric Vehicles. Hospitalier. *L'Ind. Elec.*, May 10; abstracted at some length in *L'Eclairage Elec.*, May 15.—The beginning of a reprint of a recent paper before the International Society; the first journal mentioned contains considerably more of the data than the abstract. In discussing the power of horses he shows that a horse will develop a power of 500 watts and a total energy of three kilowatt hours, which is equivalent to about one watt per kgr of the animal and five watt hours per kgr. He limits himself to accumulator vehicles, for which he suggests the name "accumobiles;" a pneumatic tire increases the economy 30 per cent. and more as compared with iron-tired wheels or those of solid rubber; the latter under certain circumstances involve a greater traction resistance than iron-tired wheels. Considerable improvement has been made in accumulators; those of Fulmen for a weight of seven kg have been built to deliver 1.5 watts per kgr and 30 watt hours per kgr for low rates, while for rapid rates the power is 10 watt hours and the energy not less than 20 kw hour per kgr; one can count on 200 kg per kw and on 40 to 50 kg per kw hour; the efficiency of motors can be taken as 75 to 85 per cent., and their weight as 15 to 20 kg per hp; these motors have the advantage over oil motors in their self-regulating property; in the oil motor the torque is constant; when the power is to be increased as on grades the speed of the motor must be increased instead of being diminished as would be natural; it therefore diminishes its speed when it ought to increase it; the electric motor regulates the pace according to the work demanded of it. The well-known advantages of electric vehicles are enumerated and discussed; regarding recharging the three systems are discussed, a slow charge at night being recommended as best; he suggests the use of batteries having a capacity of one kilowatt, and kept in stock, charged, at various places where they are to be exchanged for the empty batteries (he presumably refers to their use for a public system of hacks). An electric carriage would weigh about a ton without passengers, and would run about 75 to 80 km per day, for which a battery of 300 kg would suffice, and would consume power 10 kw hours; the cost of the energy would therefore be 60 to 80 cents a day as a maximum; the cost of maintenance, which can only be estimated, would not exceed 60 cents a day; he concludes that such vehicles would therefore have a very good future before them.

Horseless Vehicles. Salomon. Lond. *Elec. Eng.*, May 21.—A long abstract of a Society of Arts paper dealing with the subject from a technical standpoint and referring also to British patent law. He favors solid rubber tires instead of pneumatic, steel tires being even better on good roads; his experience did not show that the pneumatic tires were much better, except on bad roads; he holds that steam is the most suitable for real work; the secondary battery is either too heavy or if light too costly in repairs; there is no evidence that the vibration did harm and reduced the maintenance; he speaks favorably of celluloid retaining cells and the use of celluloid wool between the plates; the cost of energy would be about one-third more than that which was produced on the vehicle, and it would, therefore, cost about 8 cents per kw hour; one kilowatt per horse-power was the approximate expenditure per hour for a motor not exceeding six horse-power; the cost of the power is considered enormous; electric energy might do very well for pleasure riding, but not for carriages used commercially. The motor should be based on an average speed for the worst conditions; for a one-ton vehicle he fixes on 12 miles per hour for climbing a hill of 1 in 10; for every ton not less than 10 horse-power should be carried (meaning a maximum and not a mean). In the discussion, Thornycroft favored electricity for light work and steam for heavy work; Beaumont claimed that there were cases where each method was the most suitable; he considered it a waste of fuel to mount such a grade at such a speed.

Overhead Transportation of Baggage.—L'Elec., May 8.—A well-illustrated description, including working drawings, of the system used in the Victoria railroad station at Manchester, England, and which was referred to and described in these columns a year or two ago; it consists of a small electric motor running on two overhead rails and carrying a large basket filled with baggage; it is operated by an attendant sitting next to the motor.

Monorail System. Pierard. *L'Elec.*, May 15.—An illustrated description showing some of the details of the car of the Lartigue-Behr system as exhibited at Tervueren; the system is intended for high speeds and the general arrangement is already well known. There is one rail at the top of an inverted V-shaped structure, on the sides of which are four guide rails, making five rails in all; the car is 18 meters long and can carry 100 passengers; it rests on two trucks, each having four wheels on the upper rail, and it appears that each is driven by a motor developing 110 kw and weighing three tons, this power being required for a speed of about 90 miles per hour; each truck has 16 guide wheels, thus making a total of 40 wheels per car; the total weight is 47 tons, or about half a ton per passenger; the centrifugal force at this speed is about 16 tons; the cost of the system, including everything except the land, is estimated to be from $25,000 to $40,000 per klm.

Accumulator-Trolley System at Hanover. Ross. *L'Ind. Elec.*, May 10.—A long abstract with some of the curves and tables of the article noticed in the *Digest*, April 24. The Lond. *Elec. Rev.*, May 21, publishes a translation in part of the original article.

Surface Contact System.—L'Elec., May 15.—An illustrated description of the Lacroix system, which has been referred to in these columns before.

Generation of Electrical Energy for Tramways.—Lond. *Elec., and Elec. Eng.* May 21.—A reprint of the discussion of Raworth's recent paper; it refers mainly to the mechanical engineering features of a power house and includes a table by Carter giving a comparison between the generating expenses of steam-driven power stations for traction and lighting, as the figures of Raworth were obtained from cotton mills.

Conduit System.—Elec. Eng., May 26.—An illustrated description of the K. A. K. system which is said to have been running satisfactorily at Springfield, Ohio; it is claimed that it is easy to introduce this system in a cable conduit.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High-Voltage Fuse and Lightning Arrester. Fischer-Hinnen. *Elek. Zeit.*, May 6, and *L'Eclairage Elec.*, May 8.—An illustrated description of a simple form which he devised a number of years ago; it consists of a porcelain cylinder, on the outside of which is a deep, coarse, screw-thread, into which is wound the fusible wire, the top of which is connected to a metallic rod extending through the centre of the cylinder, both terminals being therefore at the bottom; the few ampere windings generated in this spiral produces a sufficiently strong magnetic field to deflect any arc or spark toward the axes, that is, against the porcelain, no matter what the direction of the current; this was substantiated by experiments; the construction is extremely simple.

Effect of Synchronous Motors on the Power Factor of Three-Phase Installations. Klasson. *Elek. Zeit.*, May 13.—A description of some tests made at an installation in which there were a number of motors which were frequently run with a light load, thus appreciably affecting the power factor of the whole installation; a synchronous motor was then connected in circuit at the station; the results are given in a table and show that the use of such a synchronous motor increases the output of the generators very much and diminishes the loss in the lines under otherwise similar conditions.

Electric Lighting in Berlin.—Elek. Zeit., May 6.—An extract of the official report up to April, 1896; a table gives the number of arc and incandescent lamps and motors and the equivalent in gas lamps and compares them with the previous year; the total number of arcs was 11,783, incandescents 251,169, motors 1383, total equivalent in gaslights 323,250, an increase of 39,600 over the previous year.

Car Lighting.—Eng. News, May 27.—A brief description of the Moskowitz system (which was described in these columns some time ago) in its improved form, as adopted by the Atchison, Topeka & Santa Fé Railway; in the present form only one belt is used.

Current Controller. Frene system. *West. Elec.*, May 29.—A translation, with the illustration, of the article which was noticed in the *Digest*, Sept. 5, 1896.

WIRES, WIRING AND CONDUITS.

Calculation of the Most Economical Cross-section of Conductors. CATANI. *L'Eclairage Elec.*, May 15; an abstract from *L'Elettricista*, April 1.—The Kelvin law cannot always be applied, and to meet this the author gives a general but simple method of application; it seems to be based on two equations, one of which is that the differential of the sums of the lengths times the squares of the diameters is zero, and the other is the simple equation for the loss of voltage; these two, he states, enable one to solve any problem. This is illustrated by several algebraic examples, in which he obtains a number of equations based on the specific conditions and from these finds the desired quantity.

Calculation of Alternating Current Circuits. ALIAMET. *L'Elec.*, May 8 and 15.—The conclusion of his article (see *Digest* May 22); the various alternating-current systems are worked out with examples. Among his conclusions he states that in large low-tension cables, even though short, but when the current is great, the fall of potential by inductance may be very great; the distribution by low-tension feeders is therefore very limited with alternating currents, especially if the frequency is relatively high.

Uninsulated Pipe for Interior Wiring. ZINGLER. Lond. *Elec. Rev.*, May 21.—The conclusion of his article. He continues the practical hints in the use of uninsulated pipes. Among other things he states that in practice he found that the section of the pipe should not be less than three times the section of all the wires in it; the fewer the wires in the pipe, the better; he gives a small table based on this rough rule; the highest grade of wire should be used and preferably not braided.

ELECTRO-PHYSICS AND MAGNETISM.

Cathode Rays. J. J. THOMSON. Lond. *Elec.*, May 21.—A reprint of his Royal Institution discourse, a brief notice of which was given in the *Digest* last week; it is in his characteristic lucid style and contains much of interest. After giving a brief history of cathode rays, dating back to Pluecker, 1859, he gives a brief account of some of the more recent investigations. He discusses the chemical properties, including thermo-luminescence, and then describes some experiments with their behavior in the magnetic field; with an ordinary discharge at pressures much higher than that at which cathode rays begin to be generated, a magnetic field pulls the charge aside as though it were a stretched elastic string, and he contrasts this with the behavior of cathode rays, the effects of which are illustrated; the cathode beam consists of rays that are not all deflected to the same extent, developing the Birkeland magnetic spectrum; the path of the rays is independent of the nature of the gas; the non-deflected rays do not seem to exhibit the characteristics of cathode rays; experiments lead him to adhere to the theory of projected electrified particles; an experiment showed that a charge of negative electricity follows the course of the rays; experiments are described showing that when the negative rays come up to a conducting plate even as thick as a millimeter, the opposite side of that plate acts as a cathode and gives off cathode rays; deductions from Lenard's experiments are made tending to confirm his conclusions, that the distance through which the rays travel depends only on the density of the substance. He concludes by making deductions concerning the size of the carriers of the electric charge, which lead him to the hypothesis that atoms are aggregations of small particles all similar to each other, which he calls corpuscles, and that at the cathode some of the molecules of the gas are split up into these corpuscles, which are then charged negatively and moved with a high velocity; they are supposed to be able to thread their way between the interstices of the molecule; their main free path would depend only on the density, which is Lenard's result; it also explains the magnetic spectrum; he calculates the ratio of the mass of these corpuscles to the charge carried by them, the results favoring the hypothesis that the carriers of the charges are smaller than the atoms of hydrogen; the ratios are of the same order as the values deduced by Zeeman in his recent experiments.

Dissociation of Atoms. G. F. FITZGERALD. Lond. *Elec.*, May 21.—An article discussing the hypothesis advanced in a lecture by J. J. Thomson that atoms are dissociated into corpuscles (see abstract of Thomson's lecture above). He discusses the possible correctness of this theory and points out some interesting possibilities that it might lead to, one of which is that one ought then to be able to transmute any substance into another by passing it through the cathode rays, assuming that the re-aggregation of the corpuscles depend upon the electromagnetic or other conditions which are under control and not on the nature of the atoms; there would be a number of possible explanations of the transparency of media to cathode rays; it might give a possible reason why the mass of matter may change when it changes its chemical constitution. He hopes that Thomson is right in his hypothesis, which he (FitzGerald) considers by no means impossible; "it would be the beginning of great advances in science and the results it would be likely to lead to in the near future might easily eclipse most of the other great discoveries of the 19th century, and be a magnificent scientific contribution to this Jubilee year."

Electric and Magnet Forces of Atoms. RICHARZ. *Elek. Zeit.*, May 13.—He argues in favor of the theory that all ponderable atoms have an elementary quantity of positive or negative electricity; the amount of this charge can be calculated approximately from the work required to separate two charged atoms and experimental determinations agree well with the calculated values; he argues that the two atoms which form a molecule of the gas have a motion around each other like a pair of double stars, and here again the calculated results agree with the assumptions. He explains molecular magnetism by the rotation of this elementary charge, and finds an agreement with a calculation by Du Bois; he also obtained approximate calculations of the maximum specific magnetization of iron; light emission and magnetism are explained by him on the basis of oscillation or rotation of the elementary charge. An abstract, with some of the mathematical deductions, of a paper on this same subject by that author is given in the *Lond. Phys. Soc.*, May.

Adjustable X-Ray Tubes. SWINTON. Lond. *Elec.*, May 21.—A brief illustrated description of a tube in which the cathode is on a sliding support so that it can be moved axially to a very small extent in and out of a tubular neck in the tube; with this he found that the exact position of the cathode had an enormous influence on the penetrative value of the X-rays produced; a movement of about one-third of an inch reduced the penetrative power of the rays to almost nothing, and within this distance every grade of penetrative power may be obtained; the resistance of the tube is much the highest when the cathode is farthest from the anti-cathode and this gives the greatest penetration, and is closely connected with the proximity of the cathode to the class which is greatest in that position; he noticed that the resistance is so important that it more than neutralizes the effect of the alteration of the distance between the cathode and the anti-cathode.

New Property of Cathode Rays, Showing Their Complex Composition. DESLANDRES. Lond. *Elec.*, May 21; abstracted from the *Comptes Rendus*, 124, p. 945.—A description of an experiment showing a curious division of the rays; the cathode was a plane circular disc and the tube contained a field explorer in the form of a movable cork carrying an insulated screen with a slit; there is also a bare metallic wire parallel to the slit and connected to the outside of the tube; deflections were then shown on the glass of the tube; a dispersion was produced by the action of neighboring bodies, resembling the action of a magnet found by Lenard and Birkeland; the complex nature of the cathode rays was thus pointed out.

Electrostatic Deviation of Cathode Rays. MAJORANA. *Proc. Lond. Phys. Soc.*, May; abstracted briefly from the Italian.—A cathode repels cathode rays and an anode attracts them; two bundles of cathode rays repels each other far less than the repulsion produced by a second cathode or the attraction by an anode; the deviation depends upon the rarefaction of the gas but is independent of the strength of the discharge.

Röntgen Rays in Chemistry. VON HEMPTINNE. *Proc. Lond. Phys. Soc.*, May; a brief abstract from the *Zeit. Phys. Chem.*, 21, p. 493.—He shows that electrolytic conductivities of solutions do not seem to be altered by X-rays and hence probably the ions are not discharged by the rays; saponification of the esters is not effected; substances sensitive to light gave no appreciable results.

Visibility of Röntgen Rays. BRANDES and DORN. *Elek. Zeit.*, May 6; abstracted from the *Wied. Ann.*, 60, p. 478.—An account of their experiments published about a year ago, with some subsequent matter; they found that even in the normal eyes of some persons excitement was produced by Röntgen rays.

Experiments with Vacuum Tubes. KORDA. *Elek. Zeit.*, May 6.—A reprint of an Electrical Association paper describing a number of experiments; some of these were made with incandescent lamps with broken off filaments; as the vacuum was generally too high he allowed some air to enter through a small hole made with a spark and afterwards sealed it with sealing wax; a light effect was produced around the terminal connected with the coil, which is increased by bringing the lamp near to the other pole; he shows the discharging action of cathode rays; also that cathode rays may be formed in low vacuum tubes such as Geissler tubes by connecting them in series with a spark gap; he also shows a dissymmetry in the distribution of the potential in the tube when cathode rays are produced and finds that this dissymmetry is only in that part of the tube on which the Röntgen rays strike; he examined with a spectroscope the fluorescent spot produced on the glass by the cathode rays; with a platinum reflector he obtained a continuous spectrum of platinum and nitrogen and when they strike the sodium glass the spectrum of sodium was clearly visible; he thinks the effects are of a thermic nature.

Radiant Discharges. HOFFMAN. *L'Eclairage Elec.*, May 8; abstracted from the *Wied. Ann.*, 59, p. 269.—A long abstract of the paper on these discharges and their relation with cathode and Rontgen rays; he shows that thermo-luminescence is caused by a particular kind of rays; he states that there is no proportionality between the intensity of Röntgen rays and the brightness of the fluorescence.

Thermo-Luminescence by Röntgen and Becquerel Rays. BORGMAN. *L'Eclairage Elec.*, May 8; and *L'Ind. Elec.*, May 10; from the *Comptes Rendus*, 124, p. 895.—He repeated the experiments of Hoffmann with the discharge rays of Veederman and endeavored to find whether the thermo-luminescence was not also produced by X-rays and Becquerel rays; he found this to be the case for a mixture of calcium sulphate with 5 per cent. sulphate of manganese.

Electric Properties of Radiations Produced by the Action of Light. LE BON. *L'Eclairage Elec.*, May 8; from the *Comptes Rendus*, 124, p. 892.—Descriptions of experiments from which he concludes that all bodies possess a property of the same kind as that of uranium but to a less degree, at least as far as it concerns their action on the electroscope.

Black Light. Perrigot. *L'Eclairage Elec.*, May 8.—An abstract of an Academy paper in which he shows that the results obtained by Le Bon were due to what photographers call solarization.

Formation of Mercury Films. Appleyard. Lond. *Elec. Rev.* and *Elec. Eng.*, May 21.—An abstract of a Physical Society paper. If a current is passed through mercury separated into two parts by a sheet of damp leather or similar substance, an adherent film of mercury is deposited on the side toward the positive pole. A sheet of tinfoil between filter paper becomes perforated with pinholes "when the current is passed between the outside surfaces," whether the electrodes are mercury or metal plates. When a gold coin is placed on the folds of filter paper a current produces a gold discoloration penetrating the folds.

Conductivity. Braun. *L'Eclairage Elec.*, May 8.—Abstracts of three papers from the *Wied. Ann.*, 59, pp. 673, 682 and 688; the first is on anisotropic superficial conductivity, in which he demonstrates its existence. The second, which is supplementary, is on an electric property in the layer between solid and liquid bodies, showing that the thin layers have the property of holding a residual charge. The third is on the conductivity of electrified air, and it shows that air acts as though it were formed of particles capable of receiving a charge and moving in an insulated medium, but they take the charge only when they arrive in the regions where the density is great.

Time Variations of Variable Currents. Braun. *Elek. Zeit.*, May 6; abstracted from the *Wied. Ann.*, 60, p. 552.—A description of a method for demonstrating and studying the variation with time, of variable currents; it depends on the property of cathode rays to be deflected by magnetic forces; he uses a long vacuum tube with a cathode at one end and a phosphorescent screen inside of the tube at the other end; there is a small magnetizing coil near the diaphragm end, the axis of which is perpendicular to that of the tube, and the current to be measured is passed through this coil; the spot of light will then oscillate; there is neither inertia nor a natural vibration period to interfere with the results; the spot of light is examined by means of rotating mirrors; it may be used for measuring and showing phase differences.

Electricity from Feathers and Hair.—L'Elec., May 8.—An abstract from a recent paper by Schwarze, read before the Association of Naturalists in Hamburg. Experiments were made with the electrification of feathers and hair, and among other things he shows that in flying through the air feathers are electrified positively and the white down negatively, causing an attraction which smoothes down the feathers; another result of this is that even in the strongest wind the feathers rest closely to the body owing to this electrical attraction.

Magnetic Properties of New Forms of Iron and the Steinmetz Coefficients. Ebeling and Schmidt. *Elek. Zeit.*, May 13.—A report from the Reichsanstalt giving more in detail, the results of researches which were referred to briefly some time ago. With cast metal they found that the ability to become magnetized varies only very little in the neighborhood of saturation; a table of the results is given; these show that a magnetic material cannot be defined by a single property such as hysteresis, permeability, etc., as two materials may agree in one of these properties but differ in the others; the newer cast materials are the most uniform; the homogeneity or heterogeneity of magnetic materials may be tested by measuring the electrical conductivity; more recent researches show that this agreement between the electric and magnetic properties may be relied upon. Experiments with annealing show that some of the cast irons may be so improved by annealing that they are only slightly inferior to the best wrought iron. Some results for sheet iron are given; there was quite a difference between samples taken from the middle and from the edges of sheets. They investigated the Steinmetz coefficient for magnetic hysteresis which was claimed to be independent of the maximum induction for the same material; but they found quite appreciable departures from this rule, and they believe the differences will even be greater in practice; accurate tests showed a tolerably good agreement for steel, but for soft wrought iron and cast steel the differences in this coefficient were greater than those obtained by Steinmetz; this coefficient can therefore not be considered a constant of the material.

Effect of Temperature on Magnetic and Electric Properties of Iron. Morris. Lond. *Elec. Rev.* and *Elec. Eng.*, May 21.—An abstract of a Physical Society paper describing investigations concerning the permeability, hysteresis and resistance of iron at different temperatures; the coil could be heated to 1050 degrees C; the only conclusion given in the abstract is that the hysteresis diminishes with temperature and nearly vanishes at 764 degrees C.

X-Ray Arc. Woodward. *Elec. Eng.*, May 26.—A brief illustrated description of a vacuum tube containing two terminals ending in small beads separated from each other by 1-16 to 1-2 inch, according to the strength of the current to be used; the high potential current is passed through powerful condensers, from which the short, thick, disruptive spark is used; he believes this to be the most plentiful and valuable source of X-rays in use to-day; the rays also appear to have almost twice the penetrative power; the tube can be made very small without diminishing its efficiency.

Magnetic Increment of Rigidity in Strong Fields. Day. *Am. Jour. of Sc.*, June.—He studied the magnetic rigidity of filamentary wires in its variation with the thickness of the wire; the paper treats of the increase of resistance due to torque produced by magnetization of twisted wires of various diameters when the magnetic field is much above saturation; he compares magnetization and magnetic rigidity, showing that the two are quite distinct in character, the former practically subsiding in relatively weak fields, while the latter is not as complete even in the strongest fields; magnetic saturation is therefore but one phase of a magnetic phenomenon of a wider range. The increment of rigidity varies in proportion with the field more and more regularly with the twist, the tendency in infinitely large fields being that the increment is proportional to the twist.

ELECTRO-CHEMISTRY AND BATTERIES.

Gold, Zinc and Electrolysis. Andreoli. *L'Elec.*, May 8.—The beginning of an article with this title which seems to refer chiefly to the electrolytic methods of obtaining gold from its ores and more particularly to the author's own method; in this peroxidized lead plates are used as the positive pole and iron as the negative, the gold on the iron being dissolved off by immersing the plates in molten lead. He makes the lead peroxide plates by immersing the well-cleaned plates in a warm solution of plumbate of potassium, making them the anodes, with cathodes of iron; with a current of 100 amperes per square m. a sufficient layer of oxide is formed in two hours. He compares this system with that of Siemens and with the zinc method, showing the great advantages in favor of the first; gold containing zinc is difficult to refine and the alloy has not a constant composition throughout the same ingot; with lead the mixture is uniform and the lead is separated out by coupelling; much more lead is required in the Siemens process.

Carbide of Calcium Plant. Guye. *L'Eclairage Elec.*, May 15—A description, without illustrations, of the plant at Vernier near Geneva; about 1000 hp are used at a cost of $6 to $7 per electrical hp per year, the energy being obtained from the water-power installation at Chevres; special care is taken to have the product as pure as possible; a very pure coke is used; each furnace requires 500 hp in the form of 600 amperes at 57 volts; they are said to be the largest in use for making this material; an approximate calculation shows the cost to be about $31 per ton, the cost of coal being very great; the daily production is about 6 tons; the bi-phase current is furnished at 2700 volts and a frequency of 45; the furnaces are on trucks to facilitate manipulation.

Creeping Salts in Batteries.—L'Elec., May 8.—Cammerman avoids the creeping salts in the usual batteries by covering the jars with a mixture of 100 parts by weight of white vaseline and 10 parts of best quality mineral wax (presumably paraffin).

Purification of Water.—Elec. Jour., May 15.—A brief description of a method recently exhibited in Philadelphia. The water passes between aluminum electrodes arranged like the plates of a battery, a direct current passing from the positives to the negatives, the water flowing between the plates, and as it passes out a blast of ozonized air is forced through it; the oxide of aluminum formed carries down some of the impurities and the ascending gas carries the lighter ones to the surface, where they are removed as scum; ozone is produced by a powerful spark from a transformer. The apparatus is claimed to require less floor space than any other and the cost is said to be less.

Direct Union of Carbon and Hydrogen. Bone and Jordan. *Am. Jour. of Sc.*, June.—Abstracted from the *Jour. Chem. Soc.*, Jan.—Carbon unites with hydrogen at about 1200 degrees; in an electric arc in hydrogen methane and acetylene are both formed; there is a final state of equilibrium, as is also the case when the arc is in an atmosphere of either methane or acetylene.

Extracting Metals from Their Ores. Schnabel. *El'ty*, May 26.—A reprint of almost all of the translation noticed in the *Digest*, May 8.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Verification of Meters. O'Keenan. *L'Ind. Elec.*, May 10.—He describes the method used by a central station in Paris, with which he is connected, for the calibration of the Thomson meter, which is adopted exclusively in that section. The meter is run with a constant power which is very accurately measured in legal watts; the number of revolutions in a given time are counted and the number of watts indicated are calculated by a simple formula which is, that these watts are equal to 3600 kn divided by t, in which k is the constant of the meter, n the number of revolutions, and t the time in seconds; this test is made for a number of different watts and the results laid off, making the true watts the abscissas and the indicated watts the ordinates, the curve therefore representing the characteristic of the meter. This characteristic is always a straight line inclined to the horizontal and passing near the origin; for a perfect meter it would be a line at 45° passing through the origin; most of the lines pass near the origin; the indicated watts can therefore be represented by the usual equation of a straight inclined line, that is, $A + B\,x$, in which A represents the distance to the intersection above or below the origin and B the inclination, x being the exact watts; it therefore suffices to find two points in order to determine this curve. If A is negative the brushes exert too much pressure or the pivot is not well oiled or the bearing worn or in general the friction is too great or there are too few ampere turns in the compounding; if A is

positive the brushes are too loose or the compounding too strong; if B is greater than 45° the magnets are too weak or they are too near the axis or the temperature was too high; if B is less than 1 the magnets are too far from the axis or the temperature is too low. The use of this method in the past year and a half has shown the advantages of it. He then shows how to calculate the coefficient with which to correct the reading in a way easily understood by the consumer, but it is not often necessary to apply the correction. He then describes the application of the method to a five-wire meter in which each winding must be tested separately. In his conclusion he states that the greater majority of the meters tested have "a mean efficiency between 0.95 and 1.05" (presumably meaning that the reading may be five per cent. too high or too low), but this factor is more frequently nearer to unity than to these limits, and that among those which are in error 2/3 are too low, which is advantageous to the consumer.

Calibrating Measuring Instruments for Alternating Currents. WILKENS. *Jour. Inst. Elec. Eng.*, May; abstracted briefly from the *Beiblaetter*, 3, p. 248.—A description of the method used by the General Electric Company of Berlin. In order to be able to use the single-phase values from a transformer without correction for phase difference, the angle of phase difference is regulated by means of a phase regulator which enables the phase of the voltage current to be altered as desired; the laminated iron core is provided with a ring winding, to which a three-phase current is supplied at equally distant points, and an iron core is introduced into the inner opening; separate coils are connected to a series of contacts arranged concentrically with the ring and provided with springs; the phase of the current taken off by these springs can be altered as desired relatively to any one of the three-phase currents.

Measurement of Coefficients of Induction. GRANQUIST. *Jour. Inst. Elec. Eng.*, May; abstracted from the *Beiblaetter*, 2, p. 139.—At the centre of a coil is a magnet secured to a stretched wire and provided with a mirror, the magnet and the wire being at right angles to one another and both in the plane of the coil; with an alternating current it is set in torsional vibration, the oscillations being a maximum when those of the wire are equal to the frequency of the current, which is regulated by adjusting the length of the wire or altering the frequency; the amplitude of the illuminated slit is measured. He also uses a differential galvanometer with two such coils at right angles; when the currents have the same phase by rotating them about the wire, the oscillations may be made zero and the angle through which the coils are turned then gives the ratio of the currents. The phase difference may be measured by finding the amplitude before and after the reversal of the current in one of the coils; if an alternating current is divided between the two coils, the relation between the coefficients of self-induction of two branch circuits can be measured by making the amplitude zero, partly by the introduction of an inductionless resistance in one branch, and by the rotating of the pair of coils; the absolute coefficient of induction can be found by determining the frequency and the corresponding number of oscillations of the wire.

New Method of Measuring the E. M. F. of Cells. NEGREANU. *Jour. Inst. Elec. Eng.*, May; noticed briefly from the *Beib laetter*, 3, p. 243.—"The current from a standard cell, the internal resistance of which is p, passes through a variable resistance r as far as the point a, where the circuit branches; the first branch contains a resistance r'', the other a galvanometer, a variable resistance r', and a cell connected up in opposition to the standard cell and having an E. M. F. $=e'$ and internal resistance p'. The resistances r and r' are adjusted until the deflection of the galvanometer needle is not altered by opening and closing the first branch. The ratio of the E. M. Fs. is then given by the ratio of the two resistances."

Reading Galvanometer Deflections. HASTINGS. *Jour. Inst. Elec. Eng.*, May; noticed briefly from the *Beiblaetter*, 2, p. 138.—The reflecting mirror is perforated at the centre, or has the silvering removed at that place; behind the mirror is arranged a mark, and in front a telescope and scale, the displacement of the image of the scale relatively to the image of the mark being observed.

Measuring the Resistance of the Human Body.—Lond. *Elec. Rev.*, May 21.—A brief mathematical discussion of a method proposed by Hedley showing that only under very exceptional conditions will it be correctly measured.

Hot Wire Ammeters and Voltmeters.—Lond. *Lightning*, May.—An illustrated description of the Hartmann and Braun instruments, in which the lateral deflection of the heated wire is used to operate the pointer.

Measurements of Electromotive Forces and Currents. ARMAGNAT. *L'Eclairage Elec.*, May 8 and 15.—A continuation of his long serial on instruments and measurements.

Electric Oscillations for Determining Dielectric Constants. NERNST. *Am. Jour. of Sc.*, June; a brief abstract from the *Wied. Ann.*, 4, p. 600.—He describes a modification of his well-known bridge, consisting of a double transformer and a spark gap in the primary, the bridge being connected to the terminals of the secondary; in the place of the telephone he uses the primary of a second transformer, the secondary of which has a spark gap, the extinction of which denotes balance; it can be used for conducting fluids and for determining electrolytic resistances.

Induction Coil for Electrical Measurements. NODON. *West. Elec.*, May 29.—A short illustrated article describing a simple apparatus for making all the necessary measurements for ordinary electrical purposes where great accuracy is not required; it consists simply of a small Ruhmkorff coil, over which is placed a needle with a pointer and scale; for large currents a single turn of wire is used, for smaller ones the primary, and for measuring very small ones or voltages, the fine wire is used: by using both it becomes a wattmeter.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Swiss Telegraph and Telephone Statistics. Elek. Zeit., May 6.—A long extract containing tables and maps from the official report for the year 1896; the map shows the interurban telephone lines. An editorial discussion is contained in the issue of May 13, pointing out some of the features of particular interest and comparing the results with those in Germany. This trunk telephone system approaches the ideal, which is possible because the country is comparatively small; the systems are under Government control, and the intention is not to make it a source of revenue, and therefore the charges are very low; funds are granted freely for extending and perfecting the system; the comparison with Germany is chiefly of local interest, but it shows that the telephone is used much more freely in Switzerland; difficulties in the line construction are much greater, and it is thought that underground cables stand a chance of being adopted for future extensions, partly because the diameter may be made greater, reducing the capacity. Attention is called to a method by which the number of conversations during the busy hours may be reduced; it consists in charging slightly more for the use of the trunk lines during the busy hours, from 11 to 2 P. M.; the suggestion is recommended.

Duplex Telegraph System. POHL. *Elek. Zeit.*, May 13.—A brief illustrated description of a new, simple system which has been in experimental use in Austria for some time and has been found very satisfactory; the connections are simple as is also the apparatus, and it is easily adjusted, involving no sensitive adjustments and no very skilled attendants; when the key at the distant station is depressed it neutralizes the current coming toward that station, thereby releasing the armature of the relay. The system is praised in an editorial, where a different explanation of the action is offered.

Limit of the Standard Switchboard. PIERARD. *L'Elec.*, May 8.—A short article endeavoring to show that the Standard telephone switchboard can be used up to 1,500 or 1,600, and even in certain cases 2,000 subscribers; the width of the tables should be about 20.5 inches; the distance between the axes and the jacks should be 1 1-4 inches horizontally and 1 inch vertically; the pairs of cords are to be differently colored; the capacity of each table is to be based on the activity of the lines and the maximum number of subscribers.

Telephone Installations. WEST. *Elek. Zeit.*, May 6.—A continuation of the series, the first part of which was noticed in the *Digest*, June 13, 1896. In this series he describes noteworthy features in telephone installations and in the present portion describes, with the aid of good illustrations, the iron and wooden pole construction in Switzerland.

Marconi System of Wireless Telegraphy.—Lond. *Elec.*, May 21.—A note stating that the inventor, together with Preece, is now carrying out experiments in South Wales and that signals have been exchanged between Penarth and Weston-super-Mare, a distance of about 9 miles, the receiving instrument being a Morse ink-writer.

Bright's Terminal System at Cable Huts.—Lond. *Elec.*, May 21.—An illustrated description of a proposition by Bright for two cable-end connections to afford protection against the incursion from white ants and other destructive insects.

Magnetic Telephony. ABSTERDAM system. *Elec. Eng.*, May 26.—A brief description of this system; it appears that the induction coil had two windings, and that one end of each is disconnected from any circuits; it is therefore impossible to pass a current from one to the other to the line, but there is a transferrence by induction from one coil to the other.

MISCELLANEOUS.

Pole Finder.—Lond. *Elec. Rev.*, May 21.—A brief anonymous communication giving the following practical rule which does not require the use of pole paper. An ordinary incandescent lamp is connected to the incandescent light mains whose polarity is to be determined, a fine wire being used for one of the connections; a small arc is then formed in a break in this fine wire, and the heat generated forms a small ball of fused copper on one of the ends which in all cases is the positive terminal, the other keeps cool.

Mineral and Metal Production of the United States for 1896.—Eng. & Min. Jour., May 29.—Completed and corrected statistics for the past year. The production of copper was the largest ever reported and was equal to 467,822,923 pounds, over half of which was sent abroad. The amount of carborundum produced was 595 short tons, valued at $365,612 at the place of production, the price per kgr being $6.65.

Simple Electrical Furnace for Experimental Work. KUESTER and DOLEZALEK system. *West. Elec.*, May 29.—An illustrated description of the one described briefly in the *Digest*, March 6.

Electric Fountain for Brooklyn.—Elec. Eng., May 26.—A brief description of the one to be erected in Brooklyn; it will contain 19 focusing lamps of 6000 horse-power each.

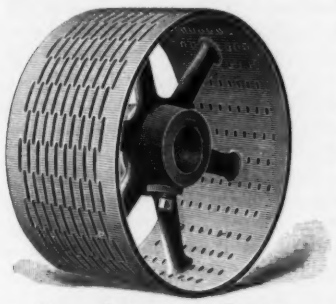
Electrical Effects on the Stage.—Sc. Amer., May 29.—Illustrated descriptions of some of the stage effects produced by the aid of electricity in the Metropolitan Opera House, New York.

Brush Apparatus in the Vicinity of Niagara Falls.

The Brush Electric Company has a large amount of electric lighting apparatus in the vicinity of Niagara Falls, which will undoubtedly be of interest to visitors to the convention. The Brush Electric Light & Power Company, of Niagara Falls, was one of the first electric light companies organized in this country. It secured water power from the company that owned the canal. The property of the old Niagara Falls Brush Company was purchased a few years since by the Buffalo & Niagara Falls Electric Light & Power Company. A new station was erected very near the large power house of the Niagara Falls Power Company, from whom it secured current to run the motors which operate its dynamos. In this new electric light station may be found four 100-light, 2000-cp Brush arc dynamos belt driven from motors. The Brush Electric Company, of Rochester, N. Y., has one of the largest arc-lighting stations in the country. These Rochester and Niagara Falls companies were among the first companies in the world to operate electric-lighting machinery by water power. The Buffalo General Electric Company has a total capacity in its large arc station of about 3000 lights. This station is located on Elk Street. About one-half of these lights are run from 65-light Brush arc dynamos. The balance of them are run from the new large Brush arc dynamos of 125 lights capacity. There are 11 of these large Brush arc dynamos. At Lockport, N. Y., there is a large amount of Brush apparatus run by water power.

A Para Pneumatic Pulley.

Notwithstanding the tendency toward the direct connection of dynamo electric machinery there is and always will be an immense percentage of belt-operated apparatus. No element in the operation of such machinery is more troublesome or annoying than the slipping and consequent power lost in the belts, frequently necessitating abnormally large belts. Even these entail a decided loss in transmission, due not only to slippage, but as well to the large weight of the moving belt and the strain on the bearings caused by the necessary belt tension. Any arrangement which does not take from the strength and simplicity of the present combination and at the same time minimizes the width, weight and tension of the belt, and also effects additional economy of operation, is undoubtedly worthy of consideration.



Para Pneumatic Pulley.

The lack of efficiency in the ordinary belts is due principally to the air cushions between the belt and pulley, causing slippage. In the Newell Para Pneumatic pulley, manufactured by the George V. Cresson Company, Philadelphia, Pa., this air cushion is entirely eliminated by means of perforations all around the face of the pulley. These perforations are regularly placed in rows parallel to the axis, the perpendicular positions of the perforations of each row alternating with those of the next. The belt closely grips the face of the pulley and operates, therefore, without the loss attending pulleys permitting an air cushion between the belt and the face.

The use of the Newell pulley enables the use of a smaller and looser belt, owing to the elimination of nearly all slip, which, with the ordinary pulley, is said to be equivalent to a loss of about 10 per cent. in power. A more uniform speed can be maintained between the driver and driven element, which is an important feature in high-speed work. Less tension on the belt means less oil in the bearings, and smaller belts means smaller first cost. The difference in the cost between a belt required for the ordinary pulley and one for the Newell is said to be more than sufficient to pay for a new Newell pulley or the reconstruction of the old one.

A New Switchboard Drop.

A novel and efficient switchboard drop has been recently invented by Mr. J. B. Perry Lewis, of the Missouri Telephone Manufacturing Company, St. Louis. In the construction of this drop Mr. Lewis employs the dynamo principle. This consists of a one-pole magnet, at the end of which the door of the drop is supported. The shape of the bottom of the door resembles the Siemens "H" armature. The magnetic attraction upon the armature draws the latter around until it is overbalanced, thus allowing it to fall. The door is hung on a pin and swung between two forks cast on the front plate, which is screwed to the face of the board. A rod is placed across the board in front of each row of drops, which not only acts as a contact for the night bell, but also serves to prevent the door from falling to more than a 45°-angle, thus enabling the operator to obtain an unobstructed view of the number of the drop. The socket is placed above the door at a proper distance therefrom, and the plug, which is made with a collar of hard rubber, catches and pushes the door in place simultaneously with the insertion of the same in the socket.

The switchboard on which this drop is used is of the double-plug system, which enables the operator to make a connection in two moves.

It is thought that this board will give great satisfaction in telephone exchanges on account of its simplicity of construction.

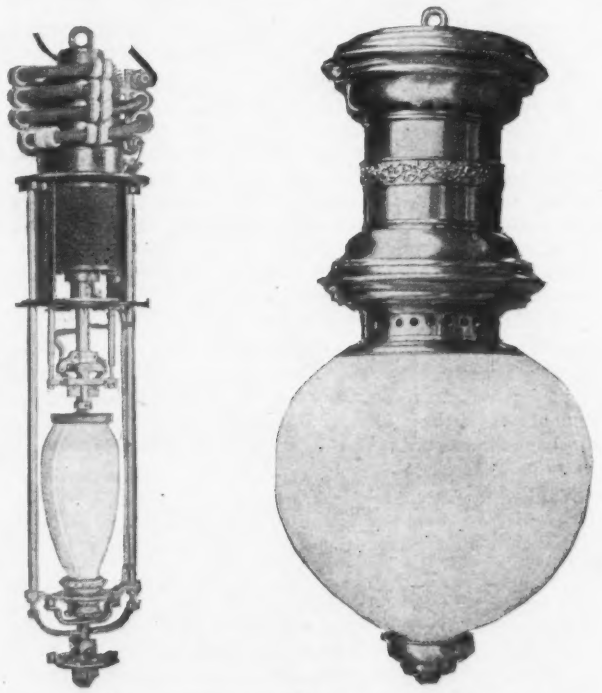
Short Enclosed Arc Lamp.

The demand for a short enclosed arc lamp for vestibules, hallways and restaurants, and in places where the ceilings are low, has been met by the General Electric Company in the single solenoid lamp illustrated herewith. This lamp is ornamental in appearance and measures only two feet in length over all. It is designed for use on 110-volt circuits, the potential at the arc being 80 volts. As in many cases for interior lighting a short ornamental lamp is desired not giving as strong an illumination as the standard five-ampere lamps, this lamp is also built to burn at three amperes with three-eighth inch carbons and a carbon life of 75 hours.

The lamp mechanism consists of one magnetic spool or solenoid which attracts through its center a tubular armature surrounding a brass tube, through which the upper carbon is fed. To the lower end of the tube is attached a clutch which grips the carbon itself instead of the carbon rod. The upward pull of the solenoid is cushioned in two air dash-pots at the top of the tube. This gives a steady lift to the upper carbon, which can drop instantly when released.

The current is taken by the carbon from a brass tube with a contact device consisting of a series of flat springs pressing upon the interior of the tube. The contact device slides freely in the tube and gives perfect contact in all positions. When trimming the lamp the upper carbon is pushed up into a spring clip in the contact device, where it is held securely without set screw or clamp. The five-ampere lamp has a carbon life of 100 hours and uses seven-sixteenth inch carbons. It is provided with three loops in the spool winding, by means of which the lamp may be adapted to 4, 4 1-2 or 5 amperes as desired. The five-ampere lamp is similar in appearance to the three-ampere lamp, and can also be fitted with weather proof casing for outdoor service.

In addition to the arc lamp for 110-volt continuous current circuit the General Electric Company has also placed on the market a series enclosed arc lamp for 220 and 500-volts circuits, similar in appearance to its ordinary enclosed arc lamp. The mechanism, however, is different. The regulation is effected by the differential action of a shunt magnet and a series magnet. An automatic cut-out shunts the circuit through a special resistance within the lamp, which allows each lamp to be thrown in or cut out without changing the potential of the others and, therefore, without interfering with their action. No external rheostat is required.

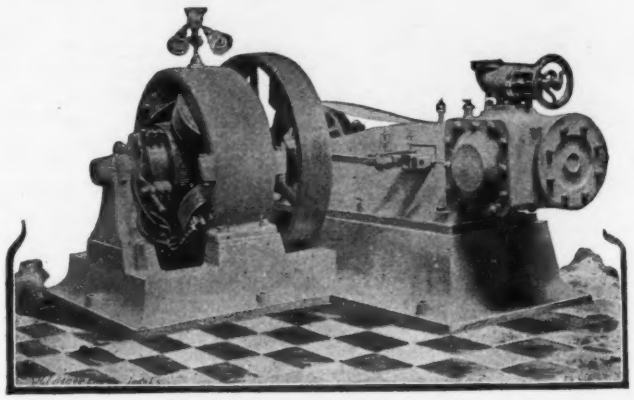


Single Solenoid Enclosed Arc Lamp.

The working potential is 80 volts at the arc and the current used is 5 1-2 to five amperes. Two lamps may be run in series on 220 volts, or five on 500-volts railway circuits, and the range and voltage within which they will operate is such that if adjusted for 500 volts they will operate satisfactorily on any voltage from 450 to 550—a range of 20 per cent. These series enclosed arc lamps are made for indoor and outdoor service.

A Direct-Connected Lighting Plant.

That the advantages of the 250-volt two-wire lighting system are being appreciated by the foremost engineers is evidenced by the increasing frequency with which they are specified and used. A recent example of this practice is found in the plant installed at Greenup, Ky., the unit in which is illustrated herewith. Long-burning arc lamps for street and commercial lighting are used, operated two in series on the same circuits. A third wire is used for the street lamps with a common return, so that the street lamps and commercial lighting may be independently controlled, and motors furnish a profitable day load.



A DIRECT-CONNECTED UNIT.

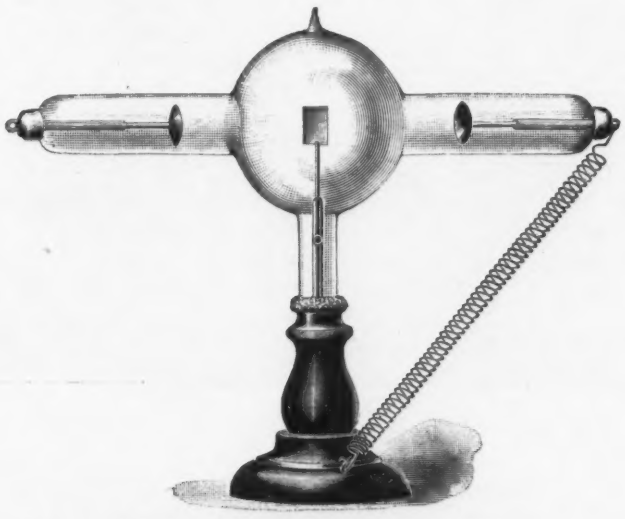
The generator is a Commercial direct-connected to a Chandler & Taylor automatic engine. The entire plant was installed by the Commercial Electric Company, Indianapolis, Ind.

A German Crookes Tube.

The American electrical trade is no doubt an alluring bait for foreign manufacturers, and despite the duties exacted on goods of foreign origin there is evidently a sufficient margin of profit possible to warrant trade competition with our home manufacturers in the same line.

Among the most prominent foreign concerns seeking an American market for its products is the Allgemeine Electricitäts Gesellschaft, Berlin, Germany, whose agent in the United States is the firm of Machado & Roller, New York City. Only recently the company completed arrangements to introduce its incandescent lamps into this country, and now we have to record another departure in quest of business in a slightly divergent line.

The illustration herewith represents a form of Crookes tube made by the Allgemeine Company, which Messrs. Machado & Roller are pushing on its merits. The most striking feature of the tube is that it has two cathodes



CROOKES TUBE WITH TWO CATHODES.

set in the necks forming the horizontal axis of the circular central bulb. The latter is provided with a downwardly projecting tube set firmly into a wooden base which supports the apparatus. The anode connecting-wire passes down through the tube and pierces the wooden base, terminating in a loop for the purpose of affording a connection terminal. The points at which the cathode wires emerge from the tube into the atmosphere are well protected by metal caps, at the extreme ends of which the wire terminates in an eye. The eye terminals of the cathode and the anode provide a ready means of connection with the source of current, for which the spring shown in the illustration is utilized.

The anode, it will be noticed, is set in the central bulb at an angle of 45 degrees with the axial line of the cathodes.

It is made of platinum, as is usual, and presents two faces, one to each cathode. Its size is about 1-2 inch x 5-8ths inch, and it is cemented to the supporting wire. The cathodes are about 5-8ths of an inch in diameter and made of aluminum. The tube is 10 1-2 inches long over all and 8 inches high, and is made of the best German glass. These tubes are rated in centimetre spark lengths, the range of spark lengths varying between 10 and 50 centimetres. They may be operated with the ordinary or alternating currents.

MIRROR REFLECTOR.

CORRUGATED REFLECTOR.

Cluster Reflectors.

The illustrations shown above represent two of the three most recent productions from the establishment of I. P. Frink, New York City. They consist of sectional glass electric cluster reflectors, with three to eight lights, lined with Frink's silver-plated corrugated glass. These are among the best known diffusers of light and are adapted for use in lighting stores, waiting rooms, offices, hotels, schools, and in all places where an economical distribution of light is desired.

These reflectors have solid metal frames and are lined with silver-plated corrugated, mirror or opal glass. The glass is put in place in sections which are rigidly held in position, this method of construction giving a much superior structure as compared with the ordinary opal reflector shades, and all danger of pieces breaking and falling on goods or on the heads of those who happen to be underneath is avoided.

By the aid of special machinery Mr. Frink is enabled to produce these reflectors at the same price as the common opal reflector shade. They are specified by leading architects and engineers, and are becoming extensively used.

A Well-Known Automatic Engine.

Among the various makes and types of engines known to electric light and power managers, and to steam engineers in general, none, perhaps, has a greater reputation for general excellence and efficiency than the "Fischer" automatic engines made by the Fischer Foundry & Machine Company, Pittsburg, Pa.

The Fischer engine is known for its superior regulation, simplicity of construction and compactness. It is of the high speed type; the main bearings, the crank pin, the crosshead pin and the crosshead guides being oiled in an efficient manner from a reservoir in the bed of the engine. This particular arrangement dispenses with the use of oil cups and wipers, with the result that the engine is remarkably clean, and the consumption of oil largely diminished.

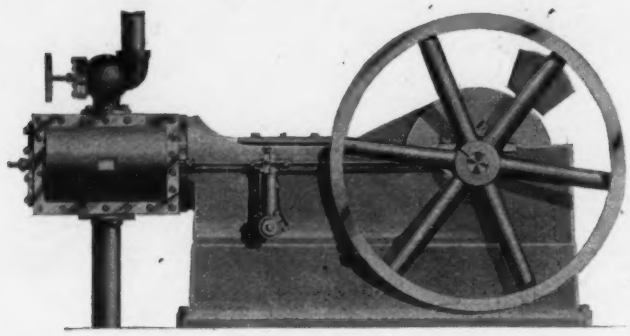
Every engine is put to a very severe shop test for forty-eight hours after it is completed, so that it can be reliably guaranteed to meet the requirements of actual work.

In the single-valve cylinder, the steam ports are made short and direct to reduce the clearance to a minimum. They are carefully proportioned with respect to the piston area and its travel, and set low in the steam chest to drain the cylinder. The cylinders are made interchangeable with the four-valve cylinders of any engine.

In the four-valve cylinders, the valves are of the four-ported type, balanced with a pressure plate. The ports are very short and direct and the clearance is in no case more than 4 per cent. They have four openings for steam, and the travel of the valves being unusually long, the port opening and closure takes place quite as quickly as in the case of cylinders provided with releasing gears, while this valve gear is much simpler and controls the valve at any part of the stroke and for all points of cut-off. The engine is equipped with a Rite's automatic governor. The piston head is hollow and light, to avoid, as much as possible, any wear on the bottom of the cylinder. The crosshead is of crucible steel, well annealed,

and the pin is hardened and ground, and pressed into position and riveted. The connecting rod is forged of mild steel, and its length is always equal to three times the stroke. Both ends of rod are of strap type and adjustment is secured by means of screw and wedge. The crosshead end of the rod is of the strap type. The crank shaft is forged in one piece of the best grade of open-hearth steel, and the rock arm is also of one piece. The hubs are split on one side and are provided with a clamping screw to secure them to the spindle.

The chief points of merit of the Fischer engine are its close regulation, durability, steam economy and interchangeability of parts. The close



High Speed, Automatic Engine.

regulation is secured by the use of a sensitive governor, which is extremely simple in construction and easily accessible. It is also easily adjusted for a reasonable range of speeds without special skill, and automatically lubricated while running. Durability is obtained by the use of liberal proportions of the several parts and by accurately counterbalancing the reciprocating parts to secure smooth and quiet running, and also by supplying a constant and liberal supply of oil to the bearings. Steam economy is secured by reducing the clearance to a minimum, by carefully jacketing the cylinder and steam passages, by adopting a long valve travel, and by seating the valve for the least compression consistent with smooth running.

It is stated these engines embody the good features of the best engines on the market, selected with a great deal of care with regard to their merits, regardless of the cost of production.

Arc Lamp Hanger.

The disadvantages and dangers connected with many arc lamp hangers now in use led the H. W. Johns Manufacturing Company, New York, to adopt some improvements which are embodied in the hanger illustrated herewith. With the view of furnishing an insulator having an abundance of strength, the company has adopted the interior construction of its

Arc Lamp Hanger.

Giant strain insulators, which, in trolley service, have demonstrated the excellence of pure sheet mica compressed between flat surfaces for supporting all strains and assuring a high and reliable insulation. The illustration herewith of the insulator in section shows the arrangement of the parts. These consist of an eye for the supporting cord and a hook for receiving the eye in the top of the lamp. These parts, with the sheet mica insulation, are confined in a malleable iron casing. All interstices are hermetically filled with moulded mica insulation, which also forms the petticoat and the covering for the body of the insulator. An abundance of insulating surface is provided, thus materially reducing the danger of grounds from leakage when wet. The malleable iron hook may be closed over the supporting eye in the lamp, if desired. This insulator is capable of supporting 1000 pounds.

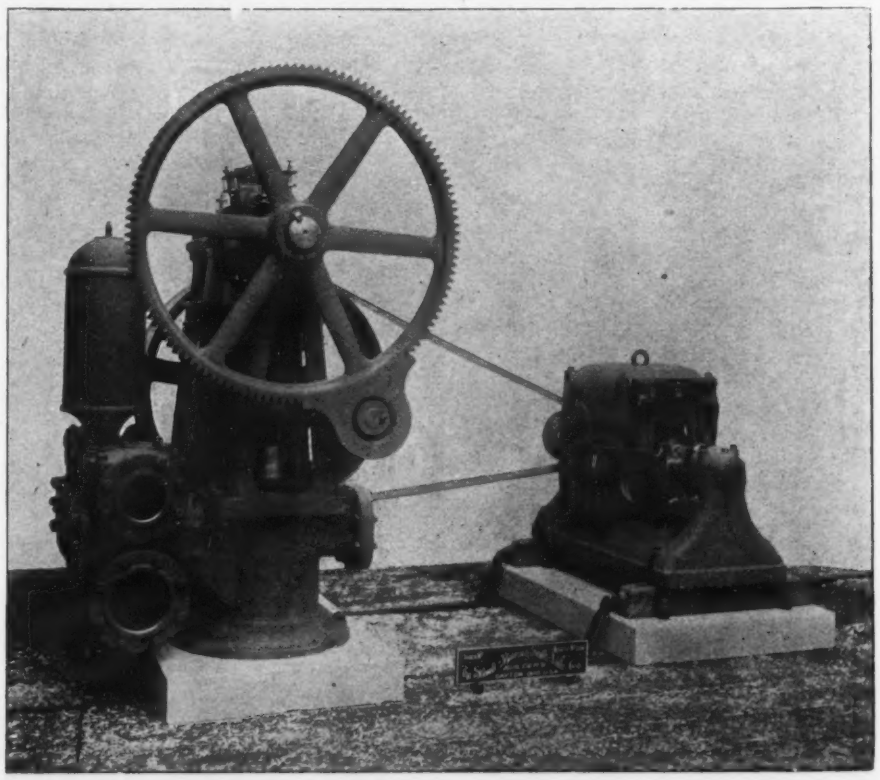
The "H. W. J." arc lamp insulator is adapted for high voltages and is of such exceptional strength that there is little probability of the lamp falling or of becoming otherwise grounded.

Triplex Power Pumps.

The problem of pumping water for towns and cities, filling tanks, hydraulic elevators, etc., at a minimum cost and maximum efficiency, is one that has taken up the attention of many of our most eminent engineers and the application of the gas engine and the electric motor in connection with power pumps has come into quite general use for this service. An improved type of vertical triplex power pump has been recently put on the market by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio. These pumps are built on the principle that a continuous action of the plungers produces a constant flow of water and resultant high efficiency. They have three plungers connected to a three-throw crankshaft, with the cranks set at an angular advance of 120 degrees. The crank shaft is supported by four housings and bearings, forming a very rigid construction and perfectly balancing the strains, which in this type of pump are very unequal. The plungers are provided with cross-heads and guides, and the cross-heads have adjustable bronze shoes for taking up wear. The connecting rods have strap heads, brass boxes and taper-key adjustments.

The pumps are made both single and double acting. The double-acting pumps are provided with removable cylinders. The gears are machine cut; the countershaft, guides and connecting-rod bearings are self-oiling, and the pumps are provided with an extra large valve area, which permits a high speed of piston travel. Ample room has been allowed for getting at the moving parts, to adjust the packing, etc., the idea throughout being to make this the most perfect machine of its type. The pumps are made in a number of sizes and weights adaptable to all kinds of service.

This company also combines the triplex pump with gas engines, the engine being arranged with a friction clutch so that it can be thrown out or in. This makes a very compact outfit and one that is easier to operate than



Electrically Driven Triplex Pump.

belts. It is becoming a matter of great importance with railroads to handle water cheaply at their stations, and they are considering this type of outfit. It allows them to dispense with the regular pumper and operate through their station man.

We illustrate a triplex pump connected up with an electric motor for buildings and elevator purposes. These pumps are built in all styles and designs, both horizontal and upright. One of the principal reasons that will bring them before the public is the greater economy that can be attained in many places; that is, with the exception of a small percentage for transmission, more economy is given than by the large type of automatic engines that are used in most factories.

A Novel Speed-Reducing Device.

The Northern Electrical Manufacturing Company, Madison, Wis., has been giving very close attention to the various questions involved in electric motor drive for machine shop practice. It has recently put upon the market a very novel device in connection with its patent invertible motor, which enables it to use a standard machine of almost any speed, and impart a slow speed to a driven machine with very little loss in transmission. The device is exceedingly compact, always self-aligning, invertible instantly to any position, without removing even one nut or bolt; the change is made by merely changing the oil drip cocks. The boxes are self-aligning, self-oiling, and the whole equipment is very compact. There being no outboard bearings the motor can be used without the base as readily as with it. All the company's standard motors are also furnished with tight-fitting portable covers for keeping out dripping of slush from floors above, or dust and dirt. These are immediately attachable to the regular standard bonnets, so that they may be used or not, at the will of the operator. These motors are especially well adapted to factories where there is much dirt and moisture, and to mines and foundries.

SPEED REDUCER.

This new device will fill a long-felt need where it has been desired to get slow speed without the expense of large cumbersome machines.

Telephone Apparatus.

The Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill., is placing upon the market a high grade of telephone apparatus made entirely in its own factory from the crude material. The apparatus is said to be entirely non-infringing and fully covered by letters patent owned by the company. It is novel, unique and original, and in quality and workmanship is claimed to be second to none. The company has an extensive factory fully equipped with modern machine tools whereby it can turn out at a minimum cost a mechanically and electrically perfect line of goods.

FIG. 1.—WALL SET.

FIG. 2.—DESK SET.

In Fig. 1 is shown a wall set. The receiver hangs upon the end of an arm hinged upon a metal box which is screwed to the base board; the induction coil, switch contacts and electrical connections are all contained within the box and the binding posts are carried upon the top. The transmitter consists of a casing made in two parts secured together with a water-tight joint and carrying a rubber mouthpiece. The diaphragm is of metal, and to prevent rusting from contact with the breath and to thoroughly prevent the entrance of moisture a supplementary diaphragm of moisture-proof material is mounted in front of the metallic diaphragm. The construction is thus moisture-proof and water-proof to such an extent that the mouthpiece may be used as a drinking cup without the entrance of moisture to the interior of the casing. The receiver consists of a metallic casing from which the horseshoe magnet extends backward, the magnet being enclosed within a rubber casing which serves as the handle of the receiver.

In Fig. 2 is shown a desk telephone, with a secret key located above the switch hook. This company installs an interior telephone system for houses in which a small switchboard is provided at each substation, whereby any subscriber may connect himself with any other subscriber, and by depressing the secret key any two subscribers may connect themselves in secret circuit, so that it will be impossible for anyone at any other substation to bridge into the talking circuit or to interrupt the conversation.

FIG. 3.—SWITCHBOARD.

The switchboard, manufactured by this company is both unique and novel in general construction and in the details of the auxiliary appliances. In order to cut the operator's telephone into circuit with any subscriber she has only to depress a push-button situated alongside the switch socket of the central station. A calling current may be sent over any subscriber's line by depressing his push-button and at the same time depressing a generator key which is common to all of the lines terminating at a switchboard. At the side of the switch socket of each board is provided a small section carrying the terminal of the trunk line extending between the several boards.

A series of keys is provided at each board whereby each operator may connect her telephone in circuit with the telephone of any other operator for making the trunk line connections. A seven-section board is shown in Fig. 3.

In Fig. 4 is illustrated an improved form of district signaling box which has recently been placed upon the market by this company. A telephone transmitter and receiver are placed within a metallic box which may be placed in any convenient location as, for instance, upon a lamppost or telegraph post. A signal-sending device is enclosed within the box and the act of opening the door operates the same. When the transmission of the signal is completed the transmitter and the receiver are automatically cut into circuit and a conversation may be held with the central station. After the conversation is finished the receiver is placed upon its hook and the closing of the door operates the switch lever, shown at the right, and cuts the transmitter and receiver out of circuit.

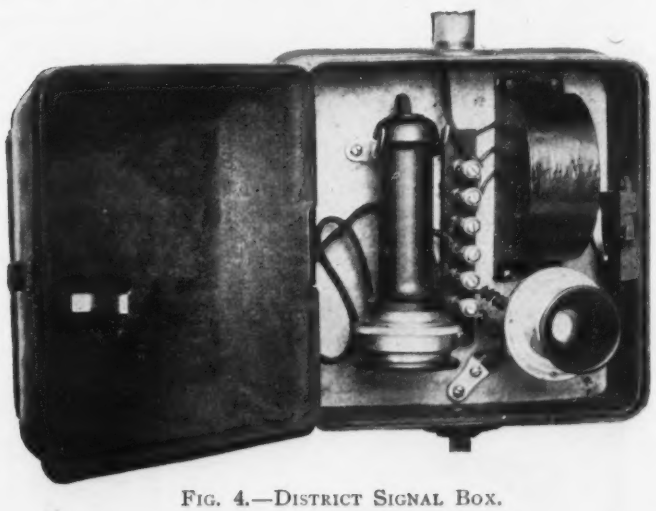


FIG. 4.—DISTRICT SIGNAL BOX.

The battery is located at the central office, so that there is nothing at the signal box to get out of order. This signaling box is readily adapted for fire, police and district alarm systems, and also for telegraph, telephone and electric railway systems. Boxes may be placed upon the posts at intervals, thus enabling a lineman or inspector to call up the central station from any point along the line.

A New Telephone Magneto Bell.

It is stated that in these days of keen industrial enterprise and competition the most successful concerns are those who give their entire attention to the manufacture of one thing, to the exclusion of everything else, and do that one thing well. An example of the truth of this is found in the case of the Williams-Abbott Electric Company, Cleveland, Ohio, which concern makes an exclusive business of the manufacture of telephone magneto bells.

This company has just brought out a new and improved magneto bell which is claimed to represent the most modern practice in telephone engineering.

In Fig. 1 is shown a front view of the generator. The magnets are made of the highest grade of magnet steel which is made especially for the company from its own formula. They are fitted with heavy cast cut gears, with epicycloidal teeth, which run very noiselessly, and combine long life and quiet running.

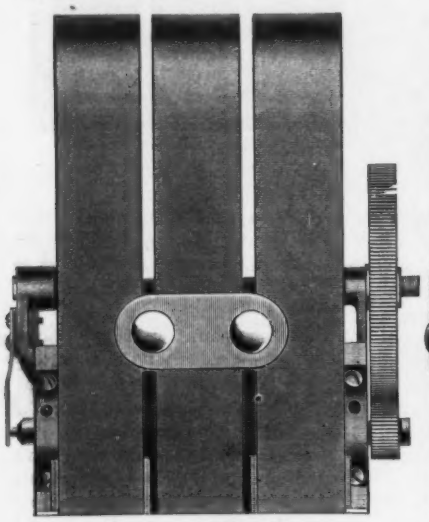


Fig. 1.—Front View.

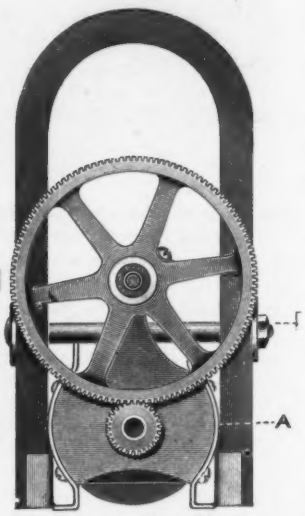


Fig. 2.—End View.

The bearings are cast on to the end pieces, and are of a special mixture of bronze. They are long and rigid.

This generator is fitted with an automatic shunt, which is located on the crank shaft. This shunt is of a very reliable and substantial type, and does not infringe. The brush used to carry the current from the armature is of spring phosphor bronze, to prevent its corrosion and loss of tension.

Fig. 2 is an end view of the generator, showing the construction of the pole pieces.

One great point of superiority in this generator over those in the older types of magnetos, lies in the fact that it utilizes about 20 per cent. more magnetism than in the older forms, by taking the magnetic contact of the pole piece and permanent magnet at or about a line horizontally bisecting the armature circle.

Fig. 3 shows in greater detail the form of the pole piece, and the seats or channels for the magnets to rest in. By the use of the flattened bolt the use of wider magnets is possible.

The diameter of the armature on this machine is 1 7-8 inches, thus permitting the winding with heavy wire, and at the same time get sufficient length to secure high voltage. The company claims that this machine has an output of 40 watts. Its standard 10,000 ohm magneto generates a pressure of 125 volts with about four times the current output of the ordinary type of magneto. This feature is a great advantage in exchange work, where there is a great deal of leakage on the lines from the tree tops, and poor insulation.

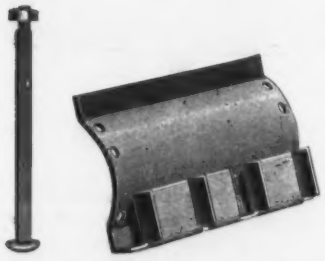


Fig. 3.—Details of Pole Piece.

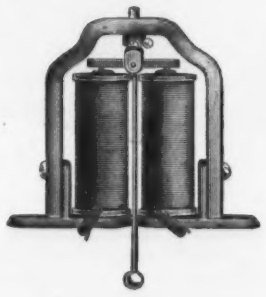


Fig. 4.—Ringer.

This company also makes four grades of bridging bells. Their mechanical construction is identical with the standard exchange bells shown in Fig. 5. The resistance of the ringers in the lowest grade, A, is 1,000 ohms; in grade B, it is 2,500 ohms; grade, C, 3,000 ohms; and in grade D, it is 5,000 ohms. This resistance is coupled with a very high inductance, permitting the use of a great number of bells on the line, without detrimentally affecting the talking qualities of the circuit. The high resistance of the ringer causes a more uniform distribution of the ringing current along the line, causing all of the bells to ring loudly. The ringer used on all of the bells of this company's make is of the tri-polar type, shown in Fig. 4.

This bell has outside binding posts, which are riveted on to brass, and are also screwed in from the back and front, to prevent their turning and forming loose contacts.

The minutest details in this bell are carefully taken care of with a view of rendering it absolutely reliable and durable. All of the parts are made interchangeable, and can be easily replaced at a slight expense.

This company guarantees all of its bells against infringement. The bells are made of the best material and put together by skilled workmen, and a test card and guarantee accompanies each. The magnets are full nickel-plated, and altogether the bell is an excellent product in all respects.

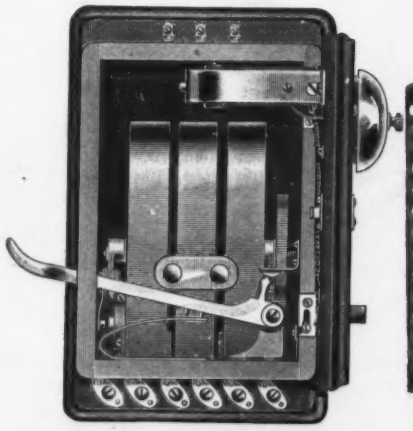


Fig. 5.—Standard Exchange Bell.

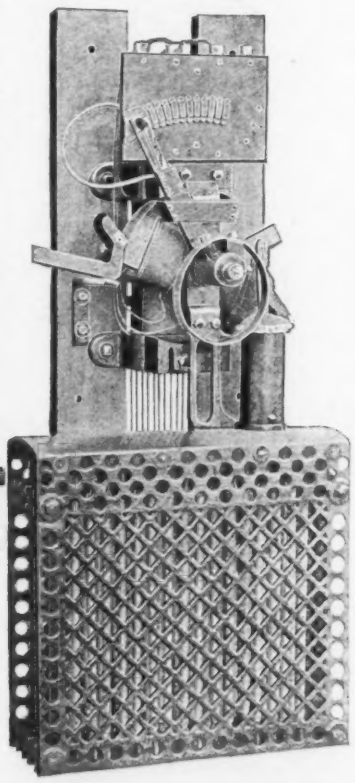
Automatic Elevator Controller.

For some months past the Card Electric Company, Mansfield, Ohio, has been experimenting and making careful tests with various forms of automatic starters or controllers for elevator motors. The result of these is shown in the accompanying illustration, which represents a motor starter containing features of construction that would seem to make it a very effective and durable apparatus for the hard duty of operating the common everyday kind of freight or passenger elevator.

The rheostat and operating parts of the starter are mounted on a neatly finished wood frame and all the connections between the rheostat and cut-out are made before leaving the factory. The construction of the automatic rheostat cut-out is simple in the extreme, and the magnetic force to operate it is very strong, far in excess of any possible requirements. This part of the apparatus has received careful attention, since the practical success of the starter depends almost entirely on the reliability of the swinging arm to properly divert current from the rheostat when the circuit is closed. The electromagnet used for this purpose is a powerful one and has a swinging armature wound and energized by the same current, which creates a powerful torque, and this torque is so controlled by the connecting mechanism that a constant, steady pull is maintained throughout the full movement of the arm. The speed of the cut-out can be made at any rate desired. All the bearings and moving parts are mounted on rollers or balls, dispensing entirely with the necessity of oiling them, and eliminating any possible danger of sticking because of accumulated dirt or friction.

The dash pot for controlling the "on" movement of the swinging arm has some novel features to insure regularity and constant speed, and the release valve in it is so proportioned and constructed that an almost instantaneous throw of the swinging arm to the "off" position is effected whenever the current is interrupted.

The rheostat used with this starter is of the well-known Card type made up of iron wire coils, mounted on iron frames, put together in a substantial manner with free ventilation on all sides. Perforated iron plates protect the front and back. The reversing switch, which is a part of the Card Company's elevator equipment, is of the quick-throw type and has carbon break tips on all the contact blades. A combination of this starter and switch with any one of the several types of motors built by the Card Company makes a very substantial equipment for either freight or passenger elevators.



Elevator Controller.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 31, 1897.

ELECTRICAL STOCKS are in nearly all cases higher and stronger in tone. Edison Illuminating of New York and Brooklyn are both higher, and General Electric, both issues, show an advance. The common stock closed the week with a net advance of ¾, and the number of shares sold was 4636. Westinghouse common is the only exception to the general advance, having lost ½ point.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	116	117
Edison Electric Ill., Brooklyn	100	106	..
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill., Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	17⅞	18¼
Electric Storage, pref	100	19	20
General Electric	100	31	31½
General Electric, pref	100	68	72
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref	50	50	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	112	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	97½	98
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	227½	..
American District Telegraph	100	.	35
American Telegraph and Cable	100	..	89
Central and South American Telegraph	100	124	127
Commercial Cables	100	162½	..
Erie Telephone	100	64⅞	65½
New England Telephone	100	106¼	108
Postal Telegraph Cable	100	100	..
Western Union Telegraph	100	80	80¼
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	19⅜	19½
Brooklyn Rapid Transit	..	18	20
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	69	71
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	42	44
Hestonville	100	49½	50
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	25	28
North Shore Traction	100	18	20
North Shore Traction, pref	100	75	78
Rochester Street Railway	..	10	13
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	102
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	77	77⅛
West End, Boston, pref	100	91¼	92
Worcester Traction	100	12	14
Worcester Traction, pref	100	89	91
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	75⅜	..
Buffalo Street Railway 1st con. 5s	100	*106½	108½
Cleveland Electric Railway 1st mtge.. 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	104½	107
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

TELEGRAPH AND TELEPHONE.—There was no marked feature in this list. American Bell Telephone is 2½ points lower, while the other telephone securities remain unchanged. Postal Telegraph is quoted 3 points higher, and Western Union advanced 2¼. The sales of the latter stock for the week amounted to 39,708 shares.

ELECTRIC TRACTIONS.—Weakness seemed to be the general characteristic of this list during the past week. There were a few advances and some losses, but the changes were merely fractional.

INCREASE OF BUFFALO BELL STOCK.—The American Bell Telephone Company of Buffalo, N. Y., has filed at Albany a certificate of increase of its capital stock from $1,000,000 to $2,000,000. The company's indebtedness is stated to be $30,000.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, June 3, 1897.

THE SEA BEACH RAILROAD between Bay Ridge and Coney Island, which is now being operated by steam locomotives, will, it is reported, be operated by the overhead trolley system.

IN NEW OFFICES.—Messrs. Baker & Co., Newark, N. J., the well-known platinum refiners, whose product is so universally used in the electrical arts, have removed their New York office to 121 Liberty Street.

THE ELECTRIC STORAGE BATTERY COMPANY has moved its New York office to the new Commercial Cable Building, 20 and 22 Broad Street and 18 and 20 New Street. The offices are in rooms 904, 905 and 906.

REMOVED.—Mr. H. B. Kirkland has removed from the Thames Building to 120 Liberty Street, where he will represent the Cutter Electrical & Manufacturing Company, of Philadelphia, and the American Circular Loom Company, of Chelsea, Mass.

A NEW FIRM OF ELECTRICAL ENGINEERS.—B. O. Ellis & Co. is the title of a firm of electrical engineers and contractors, recently organized, with offices at 136 Liberty Street. Mr. Ellis was formerly connected with the Electric Illuminating & Power Company, Long Island City, N. Y., and has had a wide experience in multiphase current work, of which the new company will make a specialty.

MR. D. W. HUGHES, of the Central Manufacturing Company, Chattanooga, Tenn., made THE ELECTRICAL WORLD a call during the week. Mr. Hughes states that his company is doing a good business in its insulator pins, brackets, cross-arms, etc. Fire recently destroyed part of one of the company's mills, but the damage did not interfere with active business. Work is now going on as usual, and the company is filling orders with its usual promptness.

MR. CHARLES E. PATTISON, for the past six years in charge of the construction and operation of the stations of the Edison Electric Illuminating Company, of Boston, has made arrangements to give up his position and to again take an active part in the business of Pattison Brothers, consulting and supervising engineers, of this city. He will continue until January 1 to give part of his time to finishing up the construction work now in progress for the Boston Edison Company, but is at liberty from the present time to act as engineer for other concerns who may desire his services.

THE STOCK TICKER SERVICE QUESTION.—On June 30 the present contracts between the New York Stock Exchange and the Gold and Stock Telegraph Company and the New York Quotation Company will expire, and the Western Union Telegraph Company, which controls the Gold and Stock Company, was notified recently by the Exchange that it (the Exchange) would not renew the contract on its expiration. A committee of five has been appointed by the Governing Committee of the Stock Exchange to mature a plan for the distribution of stock quotations after the present contracts have expired. The members of the Stock Exchange receive their quotations over the ticker service of the New York Quotation Company. This company is controlled by the Exchange, and only Stock Exchange houses subscribe to its service. President Francis L. Eames is a member, and is understood to be Chairman of the Special Ticker Committee. The members of the Exchange have been asked to submit in writing to the committee suggestions as to the best method of distributing the quotations.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 1, 1897.

ELECTRIC ELEVATORS FOR DELMONICO.—The Elektron Manufacturing Company, Springfield, Mass., has just received a special contract for the electrical equipment of Delmonico's new eight-story building in New York City. Four freight elevators and seven automatic dumb waiters, the latter being operated by the company's push-button control system, are to be installed.

A NEW DESK LAMP.—The O. C. White Company, Worcester, Mass., manufacturer of the well-known "White" adjustable holders for incandescent lamps, has added to its line of fixtures—already complete—a new portable desk lamp, which is bound to meet with universal approval. It is made of finely lacquered bronze, and is mounted on a very neat marbleized base. By a most ingenious combination of two new and original joints the lamp can be brought at once into any position with no attention whatever to fastenings. It is perfectly adapted to all kinds of desk work, whether the desk be flat or roll-top, and requires no attachment for support whatever. The conducting-cord is entirely concealed. The O. C. White Company is just placing these new lamps upon the market, and is making preparations for a large trade in this particular line the coming season.

EXHIBITION TEST OF A MOTOR-STARTING BOX.—Mr. Henry B. Cutter, president and general manager of the Cutter Electrical & Manufacturing Company, Philadelphia, had on exhibition last Friday at the office of the Bibber-White Company, its New England agent, a unique automatic motor-starting box, which the company has just perfected, and which was very highly praised by those who inspected it. The device is a combination of a starting rheostat and an under and over load I. T. E. circuit breaker. In case of either an overload or a failure of the current the circuit is instantly broken by the circuit breaker; the motor cannot then be started until the controlling rheostat lever is thrown over into the starting position by some one in attendance. Among those who examined the device were Capt. Wm. Brophy, chief electrician of the wire department, Boston; Prof. Wm. L. Puffer, of the Massachusetts Institute of Technology; Mr. James I. Ayer, of the American Electric Heating Corporation; representatives of the Boston Edison Company, and the Factory Mutual Companies, besides many other prominent electricians. A motor was run in connection with the starting box, and when short-circuited the current was immediately cut off.

INDEPENDENT TELEPHONE COMPANIES.—Messrs. Whitman & Couch, of this city, agents for the Swedish Ericsson telephones in the United States, have taken the initiative in the East toward assisting the powerful alliance, now in process of formation in Chicago, to oppose the Bell Telephone Company, by sending out the following circular to over 100 of the independent telephone companies in the East and South: "Gentlemen:—We have had so many requests asking us to call a meeting of all independent telephone exchanges in the East that we have decided to do so, provided this letter brings responses from a large enough number to make it advisable. We propose to call this meeting to decide what means can be taken for mutual protection against the Bell in case of suit, and also some means of consolidation whereby all the exchanges in the East may have a bond of fellowship and good will, and in the near future extend their lines for long-distance work and connect with the Western exchanges, which are taking a similar action at the present time in Chicago, and with whom we may act as one. If you are in favor of this meeting, and will send a representative, will you let us know by return mail, that we may call a meeting at once? There is strength in combination, and if you desire to be a party to it, kindly write any views you may have on the subject. Respectfully yours, Whitman & Couch." The responses thus far have been very encouraging, and the date of meeting will be announced very shortly.

Pittsburg Notes.

PITTSBURG, Pa., May 31, 1897.

INSULATED CONDUIT FACTORY FOR PITTSBURG.—It is reported that the Armorite Interior Conduit Company, Detroit, Mich., has leased the premises at Second Avenue and Brady Street, formerly occupied by the Pittsburg Tube Company, and will add special machinery to the equipment of the mill for the purpose of establishing in Pittsburg the manufacture of insulated iron-armored conduit for electrical purposes.

THE HOMESTEAD & HIGHLANDS STREET RAILWAY COMPANY is making good progress in its extension toward Braddock. Work has been started on a viaduct crossing the Munhall coal road at an elevation of thirty feet. This viaduct will be about 300 feet long and will be double-tracked, with a foot-walk on one side. Track construction between the viaduct and Harden Station is being pushed vigorously, and the fine bridge across the Monongahela River, between Harden and Braddock, is completed, excepting as to the channel span, which is now being erected. July 1 is the date fixed for the opening of the extension, and it is hoped to have cars running from Braddock to Pittsburg over this line, by way of Homestead, by that time.

TO WILKINSBURG ON A SINGLE FARE.—The Consolidated Traction Company has at last come to an agreement with the authorities of Wilkinsburg, and arrangements will soon be made by which cars on the Hamilton Avenue line and on the Penn Avenue line will take passengers into Wilkinsburg without a transfer and for a single fare. At present the cars on these lines run only to the city boundary, where residents of Wilkinsburg are compelled to transfer, and to pay two cents extra fare for the privilege. Under the new arrangement the Borough Council gives the Consolidated Company right of way over certain streets which it has been desirous of securing, and in return the Traction Company agrees to run cars and give accommodations as described above.

ELECTRICITY IN THE OIL FIELDS.—The Elcho Oil Company is erecting on one of its farms in Washington County an electrical power plant to supply power for pumping all of its wells in that vicinity, and also for drilling new wells. At present all of this work is done by a small steam engine at each well, involving long steam lines, great waste of fuel, and large expense for attendance. It is believed that a great saving will be made by having a single power house with electrical transmission to a motor at each well. The Carter Oil Company has successfully adopted this plan in its territory near Titusville, for pumping only, but probably the only well hitherto drilled by electric power is the one put down by the Westinghouse Electric & Manufacturing Company, near its factory at East Pittsburg.

St. Louis Notes.

ST. LOUIS, MO., May 31, 1897.

LONG-DISTANCE TELEPHONES.—Manager Hopkins J. Hanford, of the Kinloch Telephone Company, says that the Western Union Telegraph Company is prepared at a moment's notice to start a long-distance telephone system. His company intends making a contract with the Western Union, and that is why it did not take part in the convention of telephone companies, held in Chicago, to form a combination between exchanges all over the country to fight the Bell Company.

FUNERAL CARS.—A bill recently introduced in the City Council, to grant the Southern Electric road a franchise for an extension of its line from the present terminus at Howard Street and Broadway to the Fair Grounds, includes a clause authorizing the running of funeral cars in addition to mail and express. The coaches are to be finely furnished, and are designed to lessen the cost of funerals, as well as do away with the need for ordinary hearses and hacks. It is understood that the Scullin lines and the Broadway Cable Company are to take up the innovation.

ST. LOUIS CAPITAL WILL DO IT.—The East St. Louis Electric Street Car Company is contemplating extending its street car lines in several directions. The Terminal Railway Association of St. Louis controls the East St. Louis road, and it is the intention of this company to buy out the Eads Bridge Company and run through cars to the National Stock Yards, East St. Louis, from Third and Washington, St. Louis. The line will be extended to Belleville, seven miles from the bluffs, if the owners of property along the road and Belleville capitalists come to the front with the necessary stock subscriptions.

THE EDISON COMPANY'S SUCCESSOR.—A name has been selected for the company which will succeed the Edison Illuminating Company. The new corporation will be known as the Missouri-Edison Illuminating Company, and it will own both the Edison and Missouri electric properties. The Edison reorganization committee will sell the assets on June 20. The new company will be organized about July 1, and by October 1 $4,000,000 of 5 per cent. bonds will be issued. The Missouri Electric Light & Power Company will be consolidated with the new concern, and Mr. S. M. Dodd, according to the plan, will be made president.

Pacific Coast Notes.

SAN FRANCISCO, Cal., May 21, 1897.

A NEW TELEPHONE LINE.—A telephone line is being constructed by the Corvallis Flouring Mills Company, which will connect Corvallis, Ore., with Peoria.

CONTROLS ALL THE WATER POWER.—It is reported that the Redlands Electric Light & Power Company has bought out all rival enterprises controlling water power in the San Bernardino Valley. As a consequence of the new deal, the gas company operating in San Bernardino, Cal., will go out of the electric lighting business.

TRACK WELDING.—The Market Street Railway is making a trial of the track-welding system of the Falk Manufacturing Company, Milwaukee, Wis. The work was recently commenced at Twenty-second and Dolores Streets, San Francisco. Ira Bishop, of the Pacific Power Company, is the local representative of the Falk Company.

ELECTRIC-TRANSMISSION SYSTEM.—The Southern California Power Company has let the contract for the tunneling and canal on Mill Creek, near San Bernardino, preparatory to installing its Los Angeles electric-transmission system. The work is to be completed by January 1, 1898. The initial installation will consist of four units, of 1000 horse-power, each.

A TELEPHONE FRANCHISE SECURED.—The Home Telephone Company, F. W. Braun, president, Los Angeles, Cal., finally secured its franchise, and will take all the business offered. The Standard Telephone & Electric Company, Madison, Wis., supplied the 'phones used. The Columbia Telephone Company, Portland, Ore., is using 1500 Standard telephones, and 600 are in use in San Jose, Cal.

UNDERGROUND CONDUITS IN SAN FRANCISCO.—The representatives of the principal companies interested in generating and distributing electricity in San Francisco recently held a conference with Mayor Phelan, at his request. All agreed that a uniform system of underground conduits would be necessary in all future work in the down-town districts. An electrician will probably prepare a suitable plan.

ELECTRIC LIGHT TO DISPLACE GAS.—The Merchants' Association, of San Francisco, at its recent annual meeting, adopted a plan for a partial replacement of gas lamps with arc lights, during the next fiscal year. According to the plan recommended to the city, 281 arc lamps, at 55 cents each, would take the place of 1043 gas lamps, at 12 cents each. At present the moonlight schedule leaves the city without street lights eight nights a month.

General News.

NEW INCORPORATIONS.

THE APPLE RIVER POWER COMPANY, New Richmond, Wis., has been formed to develop power on the Apple River. Capital stock, $50,000.

THE CAMBRIDGE GAS & ELECTRIC COMPANY, Cambridge, Ohio, has been organized with a capital stock of $50,000. The directors are J. A. Sheperd, Ira L. Berry and Willis Vickery.

THE DARLINGTON ELECTRIC LIGHT & WATER POWER COMPANY has been incorporated at Darlington, Wis., by Frank S. Walker and T. H. Earl. The capital stock of the company is $20,000.

THE BLACK HILLS POWER COMPANY, Pierre, S. Dak., has been incorporated with a capital stock of $2,000,000. The purpose of the company is to manufacture machinery for the generation of power, and to lease or sell the same.

THE VIRGINIA ELECTRIC COMPANY has been incorporated at Baltimore, Md., with a capital stock of $10,000. The incorporators are James Sloan, Jr., James Bonday, E. J. D. Cross, William H. Gams and William A. Molinard.

THE CITIZENS' ELECTRIC LIGHT & POWER COMPANY has been incorporated at Austin, Tex., with a capital stock of $10,000. The incorporators are J. M. Colley, A. C. Green, Henry Ash, P. W. Ezell, G. L. Stevens, A. B. Hodges, C. J. Grainger, W. P. Savage and J. H. Grant.

THE BEAVER VALLEY ELECTRIC & GAS COMPANY, of Wyoming and Pennsylvania, has filed articles of incorporation at Cheyenne, Wy. This is said to be a very large corporation, and its purpose is to operate extensively in Wyoming in minerals of all kinds.

THE ELECTRO-VISUAL TELEGRAPH COMPANY, New York, has been incorporated, with a capital stock of $50,000, to manufacture electrical and other novelties. The incorporators are M. C. Ebel, F. E. Pierson, C. Spugg, George L. Mason, New York; R. M. G. Walford, Hackensack, N. J.

THE SARATOGA TRACTION COMPANY has been formed at Albany, N. Y., with a capital stock of $50,000, to construct a street surface road 2½ miles long. The directors are Robert B. Smith, Hackensack, N. J.; Charles G. Farwell, Boston, Mass.; Alfred B. Thacher, C. Herchenrach, W. S. Jenks, Charles H. Davis and S. R. Bertron, of New York City, and Theodore F. Hamilton, of Saratoga.

THE TELEGRAPH AND TELEPHONE.

ERIE, PA.—The firm of Charles E. Phelps & Co., Baltimore, Md., has been awarded the contract for doing all of the outside work for the Mutual Telephone Company, of this city. It is stated that the new plant will be one of the most complete in the United States.

WARREN, OHIO.—Arrangements have been made by the Jefferson-Warren and Ravenna-Kent Telephone Company, by which the lines in Trumbull, Ashtabula, Geauga and Lake Counties will be given connection with the Portage County system, via Mantua. The new acquisition to the system includes Garrettsville, Hiram, Shalersville, Lake Brady and other points.

JACKSON, MICH.—The organization of the Jackson Telephone Company has been completed by the election of D. A. Reynolds, of Lansing, as president and general manager; John S. Holmes, of Detroit, vice-president; Charles H. Higdon, treasurer, and Edward F. Lowery, secretary. The capital stock is $100,000, and the contract for construction has been let to the Detroit Switchboard & Telephone Construction Company. Metallic circuits will be built.

ALBANY, N. Y.—Governor Black has signed a bill appropriating $50,000 to be used by the Superintendent of Public Works for the installation of electric communication between the offices of superintendents of the canals and the several locks and other important structures thereon, to facilitate the control and management of the same and to facilitate communication with the lock tenders, patrolmen, bank watchers, captains of State scows and other employees.

MADISON, WIS.—The Dane County Telephone Company is contemplating extending its line to Mt. Horeb, and a line is being built to the latter place from Dodgeville. The western line from Dodgeville will be connected at Cobb from Montfort, where it will connect with the Grant County system, giving direct communication with Lancaster and all its connections which extend into Richland and Vernon Counties. Other connections will also be made with the Dodgeville line.

ELECTRIC LIGHT AND POWER.

ROMEO, MICH.—The citizens of this place have voted $20,000 for an electric light plant, which will be put in at once.

MARYVILLE, MO.—The Council has under consideration the establishment of a municipal water and lighting plant.

HAMMONDSPORT, N. Y.—Hammondsport will hold a special election to vote on the question of lighting the village by electricity.

WOODSTOCK, ILL.—The Council instructed a committee to investigate as to the probable cost of putting in an electric light plant.

ELDORA, IA.—In consideration of $25,000 W. S. Porter bought the Eldora electric light and steam heating plant, and it is his intention to improve the plant.

LEAVENWORTH, KAN.—Col. B. A. McKibben, president of the Home and Riverside Mines, of Leavenworth, is interested in a scheme to establish a big power plant and transmit the power to Leavenworth.

TROY, N. Y.—The Troy Gas Company, electrical department, is supplying power for a large number of manufactories in Troy, using Baxter motors of from 5 to 20 horse-power. It intends taking out all these motors at once and substituting others.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Light Company will soon commence the work of erecting a new power house, which, it is stated, will be equal to any station of the kind in the world. This undertaking was decided upon at the annual meeting of the stockholders, held on May 26, and it was then also decided to increase the capital stock of the company from $1,285,000 to $2,000,000, in order to secure the funds necessary for the contemplated improvements. The power house of the company on Eighth Street will be eventually abandoned.

THE ELECTRIC RAILWAY.

BRIDGEPORT, CONN.—The Bridgeport (Conn.) Street Railway Company, it is reported, is in need of some good men to do its armature winding.

BROCKTON, MASS.—A petition for a franchise to build an electric road on South Street to the Middleboro line has been placed in the hands of Selectmen.

HOLLAND, MICH.—It is practically settled that an electric railway line will be built here. City Attorney George E. Kollen is one of the prime movers in the enterprise.

GREENBUSH, N. Y.—The Common Council granted a franchise to the Greenbush & Nassau Railway Company to operate through the lower part of Rennssaeler City.

SOUTHBRIDGE, MASS.—The question of an electric road from this town to Charlton depot is being talked of by the business men and capitalists of both Southbridge and Charlton.

ANDOVER, MASS.—The Selectmen of Andover have granted the Lowell, Lawrence & Haverhill Street Railway a new franchise to extend a line through West Andover to Tewksbury.

NORFOLK, VA.—A force of workmen are here, and all arrangements are perfected to commence the extension of the Port Norfolk Electric Railway, as soon as the civil engineer completes his work.

FARMINGTON, MO.—Mr. W. E. Bailey and his associates have secured a right of way over the gravel road to the railway station, a distance of three miles, to operate an electric road. Work will be commenced at once.

NEW HAVEN, CONN.—Judge Robinson, in the Superior Court, has decided in favor of the public convenience and necessity of the Millford Street Railroad, which, when built, will complete the trolley system between this city and Bridgeport.

BELLEFONTAINE, OHIO.—Capitalists from Cleveland and Lima have held several conferences lately and will meet again in Lima in an effort to complete arrangements for constructing an electric road from Lima to the Lewiston reservoir, a few miles northwest of Bellefontaine.

SPRINGFIELD, OHIO.—Messrs. P. B. Hoover and C. S. Olinger have applied to the County Commissioners for a franchise to build an electric railway over the National road from the east corporation line. It is stated that the road will be run to Vienna if the oil field proves a success.

HUDSON, N. Y.—The Hudson (N. Y.) Street Railway Company is now operating and has power for six cars. Four new cars have been purchased, and the road intends putting in a new engine, generator and boiler to take care of the same. Mr. W. A. Harder, proprietor of the Harder Knitting Mill, is chiefly interested in this company.

BELLE VERNON, PA.—A charter has been awarded to the Belle Vernon & East Side Street Railway Company to build five miles of electric line in this place; thence along the river road to Rostraver Township to Donner; thence to a point near the Iowa school house, near the Monongahela River. Mr. George D. Jenkins, of Washington, Pa., is president of the company.

MILWAUKEE, WIS.—Contracts for the building of the road under the franchises granted to the Milwaukee & Waukesha Electric Railway Company have been signed. The work will be commenced within thirty days, and the contractors are William S. Reed & Co., Chicago. The lines will cover about 100 miles, and the contract calls for the construction of a complete power house. The complete system will represent an outlay of about $2,500,000.

NEW HAVEN, CONN.—It is stated that the Fairhaven & Westville Railroad will absorb all of the street railroads in the city, and that the Consolidated Railroad is at the back of the scheme. There are now three systems in New Haven, namely, the Fairhaven & Westville, the New Haven Street Railway Company and the Winchester Avenue Railway Company. If the railroads are bought outright, it is stated that $2,500,000 in cash will be necessary, and there is a mortgage of $1,500,000 to be taken care of.

OBITUARY NOTE.

MR. CHARLES LEE CROWLEY, a brilliant electrician, died at his home in Hamilton, Ohio, on May 28, in his thirty-fourth year. After leaving college Mr. Crowley rapidly advanced in his chosen profession, and was for about two years connected with the traction company in Denver, Col. He subsequently entered the service of Mr. John T. McRoy, of New York and Chicago, the conduit manufacturer. Mr. McRoy spoke in the highest terms of praise of the personal character and ability of Mr. Crowley, whose death will cause sorrow among a large circle of friends.

Trade and Industrial Notes.

ELECTRIC FANS FOR SOUTH AMERICA.—Messrs. E. B. Latham & Co., New York, general selling agents for the Hunter Fan & Motor Company, report large home orders for this well-known fan. Large shipments are also being made to South American ports.

IN NEW QUARTERS.—The Lakon Company, Elkhart, Ind., has just moved into a handsome new three-story brick building, designed especially to meet its requirements. The company will in the future be better able to attend to the wants of its customers than ever before.

MACHINERY TOOLS FOR THE GOVERNMENT DREDGES.—The Davis & Egan Machine Tool Company, Cincinnati, Ohio, has just received a large order from the Government for lathes, shapers, drill presses, etc., to be used on the United States dredge boats in the Mississippi River.

SAFETY OIL ENGINE.—An interesting pamphlet descriptive of the Priestman safety oil engine, its advantages and uses, has just been issued by Messrs. Priestman & Co., Incorporated, Philadelphia, Pa. It is well illustrated, and a good deal of interesting reading is given concerning this important and developing subject.

A POPULAR BOILER.—The Root boiler has been upon the market for thirty years, and its wide and increasing use in this country and elsewhere testify to its merits and popularity. The Abendroth & Root Manufacturing Company, New York, is well-known all over the civilized world as the manufacturers of this boiler.

BOILER INCRUSTATION.—Mr. George W. Lord, Philadelphia, has now on the press a new pamphlet of about eighty pages, which will treat in a masterly and exhaustive manner upon the subjects of boiler incrustation, corrosion, explosions and natural waters, their history, sources of contamination and the part played by them in the economy of nature.

AT THE CONVENTION.—The Keystone Electrical Instrument Company, Philadelphia, Pa., will occupy Parlor E, Cataract House, Niagara Falls, during the convention of the National Electric Light Association. A full line of its well-known instruments will be exhibited, and the company's representatives will be glad to have the members and guests give them a call.

THE FAN SEASON may now be said to be fairly opened, and a large business should be done during June and July. The Electric Appliance Company, Chicago, is in the field with a large and complete fan catalogue, showing its full line of alternating and direct-current desk, wall and ceiling fans. This catalogue will be valuable to every purchaser of electric fans of any kind.

A NEW SUPPLY HOUSE IN NEW ORLEANS.—The National Automatic Fire Alarm Company of Louisiana, New Orleans, La., has entered the general electrical supply business, and will handle electric light, telephone and house supplies. It will carry a complete line of these goods. Mr. E. H. McFall, general manager, would be pleased to receive from manufacturers of electrical apparatus a copy of their catalogues.

THE THIRD ENGINE.—The Maxwell House, Nashville, Tenn., is increasing its electric light plant by the addition of a 115-hp engine, direct-connected to a General Electric dynamo. The engine was built by the Ball Engine Company, Erie, Pa., and is the third engine furnished by it for this hotel. The Rockville Water Works, Rockville, Md., is installing an electric light plant, the engine for which was furnished by the same company.

A FINE ENGINE CATALOGUE.—The Westinghouse Machine Company, Pittsburg, Pa., has just issued a handsomely illustrated catalogue of its well-known engines. Several very fine half-tone illustrations of plants in which Westinghouse engines are installed are presented, together with a very complete exposition of their features and advantages. Besides the information imparted concerning these engines, the catalogue is valuable as a fine example of the engravers' and printers' arts.

IN GOOD HANDS.—The Western Electric Company, Chicago, has been given the agency for the Tuerk alternating-ceiling-fan motors, which are regarded by many as being the handsomest and most efficient alternating-current motors on the market. These motors are finished in bronze, bower barff, nickel, brass, and white and gold, and are provided with regulating switches and device for changing the angle of the blades. The reputation of the Western Electric Company for selling only goods of superior merit is a sufficient recommendation for the high quality of these motors.

INCREASING ITS FORCES.—The increasing inquiry and orders for its engines have led the Ball & Wood Company, New York, to add to its selling department by bringing Mr. Greenwood from its works, of which he has had charge for the past year and a half, to the New York office to assist Mr. Vincent. Mr. John D. Bird, formerly superintendent of the George H. Corliss Steam Engine Works, Providence, R. I., has resigned his position there to accept a similar one with the Ball & Wood Company, and he will in future be the superintendent, and in charge of the company's plant at Elizabeth.

REVERSING ROLLING MILL ENGINES.—The Philadelphia Engineering Works, Philadelphia, Pa., has ready for distribution to the trade a very complete description of a balanced slide-valve-reversing rolling mill engine, which it has just built for the Keystone Axle Company, Beaver Falls, Pa. The engine is well illustrated by half-tone perspective views and outline drawings, and the principal dimensions are given in tabular form. This company makes a line of horizontal or vertical, simple or compound Corliss engines, simple or compound air or gas compressors, direct or geared hoisting machines, steel plate chimneys, water-tube boilers and jet and surface condensers.

A NEW FORM OF INSULATION.—Mr. S. McPherson, 1 Nassau Street, New York, sends us a sample of a product for electrical insulation. It is applied with a brush or spray, and will insulate iron, glass, paper, copper, carbon, wood, brick, or anything that is required to be insulated. It is waterproof, fire-proof and non-corrosive, and is said to be particularly useful for rheostat and like work. The Fire Underwriters, the Fire Department and the Board of Electrical Control are giving the substance exhaustive tests with the view to demanding its adoption in all new buildings. It is also being tested at Columbia University and Stevens Institute. It comes in all colors, or clear, and is cheaply manufactured.

AN IMPORTANT AGENCY.—The C & C Electric Company, New York, has recently concluded arrangements with Messrs. Sargent & Lundy, Chicago, Ill., whereby this firm on and after August 1, next, will act as its selling agents for Chicago and the Western States. During the interim Mr. F. D. Sweeten, who has long been the manager of the C & C Company's Philadelphia office, will look after the company's interests in the territory above mentioned. The company's Chicago office is now at 934 Monadnock Block, where Mr. Sweeten will transact business until the change above referred to shall go into effect. Mr. Martin J. Insull, of Messrs. Sargent & Lundy, will take special charge of the interests of the C & C Electric Company.

SHEET-METAL WORK.—The Cincinnati Corrugating Company, Piqua, Ohio, has just received from the press its new ninety-page catalogue, containing over 125 illustrations of its many and varied lines comprising roofing, siding, arches, metallic bath, shutters and doors, awnings, and a general line of sheet-metal workers' supplies. A supplement issued in connection therewith refers to the fact that several new items have been added since the last issue, and that the company now manufactures and handles the largest and most complete line of iron and steel roofings, sidings and roof trimmings in the country. Its facilities enable it at all times to insure the promptest shipment on orders. A copy of the catalogue can be had free on application.

ANTI-CONDENSATION ROOF LINING.—The Queen Construction Company is erecting in Flushing, L. I., N. Y., a new electric light plant. The building is divided into two portions—a boiler house, 40x42 feet, and an engine and dynamo room, 43x71 feet. The walls are of brick and have substantial stone foundations, and the roof is of iron covered with metal covering. The building, when completed, will be absolutely fire-proof. The roof of the engine and dynamo room is lined with the Berlin Iron Bridge Company's patent anti-condensation roof lining, which prevents condensation of moisture on the underside of the roof, a result which is absolutely necessary to obtain in a building filled with electrical apparatus. The Berlin Iron Bridge Company has the contract for furnishing and erecting the steel frame work and the covering.

SAMPLES OF INSULATING PAPERS are supplied by the Standard Paint Company, New York, in the form of a bound book, just issued to the trade. The book contains nine samples and descriptions of the company's well-known high-grade building, sheathing and insulating papers. These goods are waterproof, odorless and air-tight. They are made of the best materials and possess great strength and durability. They are also alkali and acid proof. P. & B. products have stood the tests of years. It is stated that P. & B. compound is more generally used to-day by electric light and electric railway companies than ever before, and the claims made for these goods are based on over ten years' actual experience and practical tests. The Standard Paint Company makes only strictly high-grade varnish for armatures and field coils. It does not need baking, and is proof against oil. The company is making a specialty of a new water-proof paint for coating walls, etc. It is called "Magnite," and is easily applied. A color card can be had on application.

GOOD WORK OF A LARGE BELT.—Last year the Chicago Belting Company made a seven-foot, three-ply leather belt for the Louisiana Electric Light & Power Company, New Orleans, La., which was justly regarded with pride by its manufacturer, on account of its large size and the method employed in its construction. In a letter from the superintendent of the Louisiana Electric Light Company's station, written five months after the belt was put in, that gentleman states: "We have found that this belt is all that you have claimed it to be, and since the day it was put on the pulleys it has never given us a moment's trouble. It runs true and straight, is very even, and has stretched very little, although we have carried with it a load of 188 horse-power. The belt is made without rivets or pegs, depending only on the cement; none of the laps or joints have opened, and the belt is apparently in as good condition as it was the day it was placed upon the pulleys." This belt is 150 feet long and weighs 3300 pounds. In its make-up 450 whole hides of pure oak tannage were used, and it measures 7/8 inch in thickness.

TROLLEY APPLIANCES FOR FIGURE 8 WIRE.—The figure 8 trolley wire, though of recent origin, has already found favor with many of the leading electrical engineers engaged in railway costruction, as its adoption by many of the largest systems conclusively proves. Its selection made new requirements in the design of the construction material necessary to suspend it in position, as its peculiar and novel shape would not permit employing those devices which have been used heretofore, without making radical changes in their form and detailed construction. Two of the principal factors which had to be considered in this connection were the increased weight of the trolley wire, and the application of the various devices, so that the contacting surface of the wire would present a free and uninterrupted passage for the trolley wheel. To fill these conditions the Ohio Brass Company, Mansfield, Ohio, has placed on the market a full line of improved designs of trolley-wire devices for use with this style of wire, and has already equipped a number of roads which use figure 8 trolley wire for their overhead construction.

PRESSES AND DIES.—The Ferracute Machine Company, Bridgeton, N. J., has for a number of years made a specialty of electrical work, and it has supplied to many of the largest manufacturers their outfits of presses and dies for cutting out and notching armature discs. The company builds several very large double-crank presses for this kind of work, and has just furnished two of them to the General Electric Company; this company also having seven more of these large presses in use, which it has purchased in previous years. The Ferracute Company builds also armature-notching presses with indexing attachment for notching any size of disc from 3 inches to 24 feet in diameter, and these machines embody a number of new features. The smallest machine will notch up to 4 inches in diameter, and the largest from 2 feet up to 24 feet. The company has special facilities for making large dies, and also small accurate

dies. The company is running with a full force of workmen, and is working overtime. It issues a handsome catalogue, describing over 300 different machines, which it builds, and is always glad to give information and estimate on receipt of drawings or samples of work.

UTILITY OF CEILING MOTORS.—The Bullock Electric Manufacturing Company, Cincinnati, Ohio, reports active inquiry in the field of power transmission for its new type of ceiling motors, which can be coupled to line shafting, or belted direct to tools or shafts. The great interest shown by the manufacturers of this country, as well as by newspaper publishers, in the new methods of operating their machinery warrants a most hopeful outlook for the further development of this field. Among the numerous installations of power and lighting equipments made by this company may be mentioned: New York "Journal," New York "Sun," New York "Herald," New York "Times," Chicago "Journal," Toronto "Globe," San Francisco "Examiner," Paterson "Sunday Chronicle," Paterson Edison Company, U. S. Government Printing Office, "Munsey's Magazine," American Book Company, Winthrop Press, Kaufmann & Strauss, Mergenthaler Linotype Company, Henry Heide, Young & Smylie, the J. J. Harrington Company, Haight Building, New York City, and the United States monitor "Terror." The Bullock Electric Manufacturing Company is actively represented in all the leading cities of the United States, and the Eastern selling organization, the Bullock Electric Company (George Bullock and Robert T. Lozier), has offices in New York, Philadelphia, Pa., and Boston, Mass., and has a force of engineers for handling the entire light and power equipments for office buildings, hotels, factories, printing establishments, etc. The company does a large export business, and has sent machinery to England, France, Germany, Austria and Australia.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 25, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

582,713. TOLL APPARATUS FOR METERS; F. M. Archer, New York, N. Y. App. filed May 11, 1896. In a toll apparatus for meters, the combination of a shaft adapted to register the consumption of material flowing, a contact-point carried by said shaft, a second contact-point whose position may be set with respect to that of the first, and means whereby a key or token may be used to fix the relative positions of the two contact-points.

582,714. TELEPHONE TOLL APPARATUS; F. M. Archer, New York, N. Y. App. filed April 30, 1896. The combination with the calling instrument shaft of a telephone, a notched wheel thereon, a bolt adapted to engage the notches of said wheel, an oscillatory key-holder engaging with said bolt and means whereby a key may oscillate said holder to release the said shaft.

583,026. SYSTEM OF TELEGRAPHY; C. G. Burke, Brooklyn, N. Y. App. filed Sept. 4, 1896. The method of telegraphing, which consists in transmitting over a line electrical impulses of uniform duration at variable intervals and indicating or recording at the receiving station the intervals between impulses or the periods of no current on the line.

583,039. ELECTRIC SIGNAL DISTRIBUTER; P. H. Fisk, North Branch, Minn. App. filed Oct. 28, 1895. A series of levers actuated by electromagnets and provided with contact-points, a laterally-movable block having contact-plates in proximity to the contact-point of said lever and adapted to alternately connect electrically therewith by the lateral movement of said block, blocks slidable upon said levers and having spring-contact plates attached thereto, a series of slidable blocks upon fixed guides having contact plates separated by an inclined stop against which said spring-contact rests, and electrical connections whereby when said levers are actuated its contact-points will close a circuit through one of the contact-plates on said laterally-movable blocks, and hold it closed so long as the electric current is maintained through the electromagnets which operate said levers, and the contact-points of said levers be returned to their normal positions into electrical connection with the other contact-plates of said laterally-movable block when the current is broken through said magnets, and whereby also a current shall be thrown through a second magnet to close a circuit through the contact-plates upon said slidable blocks when they are brought into predetermined positions before the contact-points upon said levers are returned to their normal positions.

583,043. ELECTRIC HEEL PLATE; J. W. Tibbs, New York, N. Y. App. filed Jan. 16, 1897. In an insole-plate the combination with a plate element, of an opposing plate element and of a non-electric generating plate to cover the rounding edge of the upper element, the latter serving also as a means of supporting the person and as connecting means for said elements.

583,060. ELECTRIC ARC LAMP; F. A. La Roche, New York, N. Y. App. filed Dec. 22, 1896. In an arc lamp the combination of a diaphanous air-tight chamber inclosing the arc and having two apertures in the wall of said chamber at opposite points, two carbon rods, one for each aperture, passing through and making close sliding contact with the wall thereof, a free and independently-movable bushing for each aperture, a suitable clutch for each carbon rod and means for affording universal movement to each clutch.

583,104. SYSTEM OF GENERATING AND USING HYDROGEN GAS AND ELECTRICITY; L. H. Wattles, Providence, R. I. App. filed Dec. 7, 1895. In combination with a generator, or series of generators of hydrogen gas and electricity, the electric conductors connecting with the electrodes of the generator or generators, the electric dynamo-motor mechanism connected with the electric conductors, a gas duct connected with the gas collector or collectors of the generator or generators, a gas engine having connection with the gas duct and adapted to be operated by the gas from said generator or generators, and the mechanisms of the engine and motor for the delivery of the mechanical power produced by the engine and motor, being connected to the same shaft or means of utilization.

583,128. GALVANIC ELEMENT; P. Schmidt, Berlin, Germany. App. filed May 29, 1896. A galvanic battery consisting of an annular chamber, a carbon cylinder therein between two zinc cylinders, the intermediate space between the outside zinc cylinder and the carbon cylinder being filled with a current-generating paste, and the space between the carbon and the inner zinc cylinder being filled with a generating liquid, the latter of which is poured in the inner zinc before the putting together of the battery, and is conveyed into the said space as required by reversing the battery.

583,132. PRIMARY BATTERY; H. M. Sutton & W. L. Steele, Dallas, Tex. App. filed March 17, 1896. In a primary battery, the combination of the cell-case, a plurality of cells arranged within the case, a case-cover provided at its corners with metallic plates, and with interior wire-receiving grooves leading to said corner-plates, conductor-wires arranged in said wire-receiving grooves and having metallic connection with the corner-plates, the zinc or positive battery elements arranged in the cells and having metallic connections with the corner-plates and the carbon or negative elements for each cell fitted at their upper ends in openings in the case-cover and having metallic connection with the wires in said wire-receiving grooves.

583,142. TELEPHONE RECEIVER SUPPORT; L. Duque & F. M. Cosgrove, San Francisco, Cal. App. filed Sept. 15, 1896. A telephone-receiver support comprising an offstanding supporting-rod having a threaded outer tip extremity, and an oblong holding cage or basket provided at diametrically opposite sides with fixedly-positioned interiorly-threaded sockets disposed reversely to each other, and at an angle to the transverse centre of the cage or basket.

583,160. MAXIMUM AND MINIMUM RECORDING ELECTRIC METER; A. Wright, Brighton, England. App. filed June 12, 1896. The method of recording an extreme limit of the range of a variable characteristic of an electric current, within a certain period of time, by causing a movement of a body, or bodies, commensurate therewith; indicating by the extent of such movement, the said limit, and preventing further record indicating movement of said body or bodies.

583,173. EMERGENCY ELECTRIC GENERATING APPARATUS; C. E. Emery, Brooklyn, N. Y. App. filed Aug. 22, 1895. The combination with a constant potential dynamo and a prime mover for operating the same of a series dynamo in parallel therewith operated by a racing prime mover.

583,178. UNDERGROUND ELECTROMAGNETIC RAILWAY SYSTEM; J. Hoffman, Schenectady, N. Y. App. filed May 13, 1896. The combination with a feeding-wire and a contact-rail, of separated contact-boxes, each provided with a horizontal extension projecting toward the feeding wire, a movable electromagnet contact device within each contact-box, and a flexible conductor for conveying the current from the feed-wire to the said movable contact device, inclosed partly within the extension.

583,204. INCANDESCENT LAMP; A. Swan, New York, N. Y. App. filed Dec. 8, 1896. In an incandescent lamp a base having an annular shoulder of less diameter than the base and over which is fitted an annular contact-ring, the base being perforated longitudinally, the outer end of the perforation forming an undercut cavity in the side of the shoulder, into which the edge of the ring is driven to hold the ring on the shoulder.

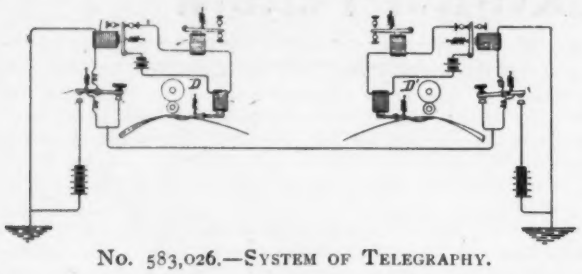
583,208. AUTOMATIC FIRE IGNITER FOR FIRE ENGINES; G. J. Brown, Chelsea, Mass. App. filed March 8, 1897. In an automatic fire igniter for fire engines, an electric burner, magnets therein, means actuated by the movement of the engine to close the circuits of the magnets and to break the said circuits after the magnets have been energized.

583,242. WIRE COUPLING AND BINDING POST; J. A. Wright, Wilkinsburg, Pa. App. filed Jan. 11, 1897. A wire-coupling comprising a plug-section having a central hole bored through the body thereof, and a cross-slot connected therewith through the threaded-shank thereof, and a cap-section also provided with a central hole through the end thereof communicating with a threaded hole adapted to fit the same shank of the plug-section.

583,264. ELECTRIC MOTOR OR DYNAMO ELECTRIC MACHINE; R. Lundell, Brooklyn, N. Y. App. filed Dec. 15, 1896. An electric motor having a field magnet consisting of two cylindrical inclosing magnetic shells having inwardly-projecting wedge-shaped pole-pieces and legs or supports cast integral therewith, in combination with a single five-sided field-magnet coil adapted to conform to the interior structure of said cylindrical parts when secured together.

583,273. SERIES MULTIPLE CONTROLLER; T. Von Zweigbergk, Cleveland, Ohio. App. filed Jan. 21, 1897. In a series multiple controller, in combination, two motors, contact fingers with which the motors are respectively connected in series and in multiple arc, a switch movable in both directions from the "shut off" position, motor contact-strips thereon, on opposite sides of said contact-fingers when the switch is in said shut-off position, and adapted to contact with said contact-fingers, trolley-strips thereon, connections between the motor-strips and trolley-strips, and fixed contact-fingers which connect the trolley-strips with the source of current, whereby the movement of the switch in one direction causes the current to pass through the motors in series, and the movement of the switch in the opposite direction causes the current to pass through the motors in multiple arc.

583,303. ELECTRIC GAS LIGHTING ATTACHMENT; W. H. Fargo, San Francisco, Cal. App. filed Aug. 6, 1896. In an electric sparking attachment for gas lighting, a tip-holder adapted to be raised and lowered in the tubing of the fixture and provided with a closed end, and an opening in the side for the passage of the gas into the holder, in combination with tubing to contain the holder having chambers of different diameters, the one exposing the opening to the passage of the gas and the other



No. 583,026.—System of Telegraphy.

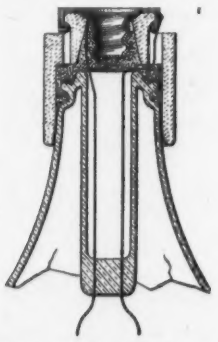
closing the same, suitable operating attachments for raising and lowering the tip holder to extend the said opening into either of said chambers, and electric contacts to complete and break the electric circuit as the tip-holder is so moved.

583,304. STREET OR STATION INDICATOR; A. C. Goetz, Cleveland, Ohio. App. filed Aug. 21, 1896. In a street or station indicator, the combination with two rollers, one located in the upper part of the case, the other located in the lower part of the case, both rollers being connected through the medium of a sprocket-chain or like communicating device, a web mounted upon and operated by said rollers, and a compensating device for equalizing the motion caused by winding on one roller and unwinding from the other, of an electromagnet located between the rollers and being suitably connected with one of the rollers, whereby the said rollers and web are operated.

583,305. OPERATING MECHANISM FOR CAR BELLS; J. T. Haskins, Malden, Mass. App. filed July 21, 1896. In combination with the bell, a push pin and mechanically actuated hammer of a car, a second hammer, electromagnetic mechanism for actuating the same, and circuit-closing devices arranged to be operated at will by the motorman, both hammers being adapted to strike the same bell.

583,309. BOND FOR ELECTRIC RAILWAYS; J. McLaughlin, Chicago, Ill. App. filed Oct. 19, 1896. In a bond for electric railways a terminal head or heads and a pin or key held permanently in said terminal head by casting or forming the head about the key or pin and means for expanding and locking the head by driving the pin or key.

583,323. METHOD OF AND APPARATUS FOR CHARGING STORAGE BATTERIES; C. C. Bramwell, Hyde Park, Mass. App. filed Aug. 22, 1895. The method of charging accumulators, which consists in having the number of cells in the charging circuit in direct proportion to the strength of said current, the discharging-circuit of the cells remaining undisturbed throughout the operation.



No. 583,204.—Incandescent Lamp.

583,324. CURRENT COLLECTING DEVICE FOR ELECTRIC RAILWAYS; W. M. Brown, Johnstown, Pa. App. filed July 18, 1896. In combination with an electrically propelled vehicle and a magnet carried thereby, a flexible member depending below each magnet pole, and a spring between and bearing against the pole and flexible member.

583,326. ENGINE STOP-MECHANISM; J. H. Cary, Springfield, Mass. App. filed May 9, 1896. In a shut-off apparatus, the combination of a steam cylinder with a piston and piston rod connecting the cylinder to a pressure valve, said valve being connected with the main steam supply, a pivoted lever to control the action of the pressure valve, a lever extending from and rigidly fastened in the armature of an electromagnet, a current indicator, a dynamo-electric or magneto-electric generator or battery, a speed-limiting attachment, a governor having a projection attached to the governor-rod to engage and operate said speed limit, a relay including an alarm-bell and its operating battery in local circuit, a resistance-coil to regulate the amount of effective current upon the line, shunt-coils to reduce the reactionary inductive effect upon the line, incident to breaking the circuit, switches or keys or a break wheel for normally opening the circuit and recording apparatus for registering a break in the circuit.

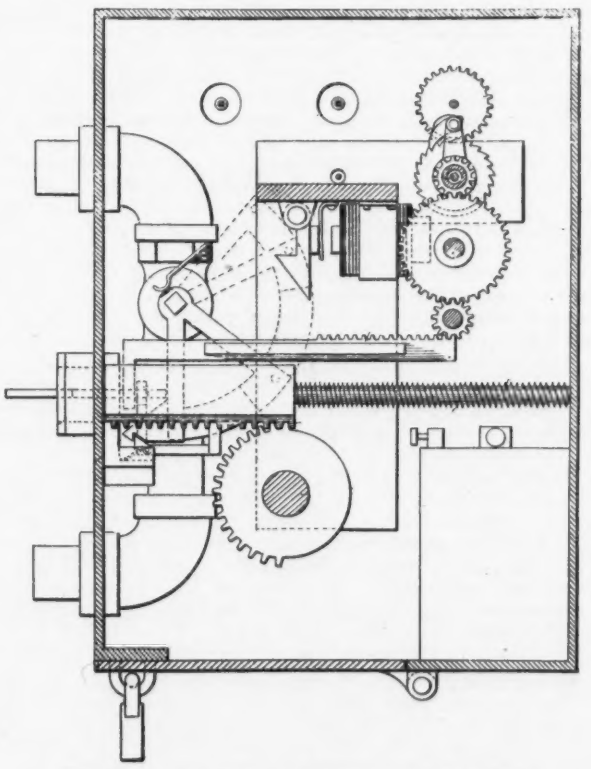
583,354. AMALGAMATOR; F. B. Austin, Tempe, Ariz. Ter. App. filed Sept. 12, 1896. An amalgamator comprising a sluice-way, a plan of insulating material arranged within the sluice-way, for containing mercury, metal partitions arranged in the pan, a carbon plate arranged in the bottom of the sluice-way above said pan, and a source of electricity, one pole of which connects with the mercury-pan and the other pole connects with the carbon plate.

583,405. SYSTEM OF PNEUMATIC DOORS AND GRATINGS; E. S. Corbett, Allegheny, Pa. App. filed Oct. 29, 1891. The combination with the piping provided with means for supplying a fluid under pressure and an alarm or signal connected with said piping and adapted to be actuated by a certain diminution of the fluid-pressure, of a hinged and swinging door having a swivel or pivot connection with the piping, and a fluid-discharge valve forming an attachment or part of such connection.

583,407. ELECTRIC DRILL; C. E. Davis, Chicago, Ill. App. filed April 27, 1896. A drill comprising a moving part by which power is conveyed to the drill-shaft, said drill-shaft being movable longitudinally with relation to said part and being threaded a portion of its length, a feed-nut engaging said drill-shaft and free to rotate therewith when there is no longitudinal pressure exerted on said drill-shaft, said feed-nut provided with a part adapted to be forced against an opposing surface by the pressure produced by the engagement of said drill with the material upon which it operates, the pressure between the parts holding the nut in position to feed the drill forward.

583,418. TELEGRAPHY; O. R. Robinson, Glen Ridge, N. J. App. filed Aug. 24, 1896. In a telegraph system, an alternating-current dynamo at a transmitting station, two transmitting keys, a main line, two receiving devices at the receiving station, and collector-segments and earth connections for directing over the main line a series of positive pulses produced by said dynamo for transmitting one message and a series of negative pulses produced for transmitting a second message.

583,423. ELECTRIC SIGNALING APPARATUS; A. D. Wheeler, Hyde Park, Mass. App. filed Feb. 2, 1897. In an electric signaling apparatus, a number of box circuits, each having one or more box-chamber circuit-controllers, a repeater connected with said box-circuits having a number of signal receiving magnets, one for each box circuit, and a number of repeating cir-



No. 582,713.—Toll Apparatus for Meters.

cuit-controllers, one for each box circuit, means controlled by any one of said signal-receiving magnets for rendering the remaining magnets non-responsive to changes in the box circuits in which they are connected, and also for rendering operative all of said repeating circuit-controllers, except the one connected with the operating box-circuit, and a recording instrument having a number of pen-magnets corresponding to the number of box-circuits, and means controlled by any box-number circuit-controller in any box-circuit for simultaneously rendering all of said pen-magnets responsive to the action of any circuit-controllers in their respective box-circuits.